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Hawker P.1127 & Kestrel

The P.1127 was the original ancestor of today's Harrier. It could also claim to be the ancestor of tomorrow's Joint Strike Fighter, the biggest programme for a future combat aircraft in the world today. Thus, this small and seemingly rather useless machine, which in its day was laughed at by the USAF and most other air forces, can be seen to have been one of the truly significant aircraft of all time.

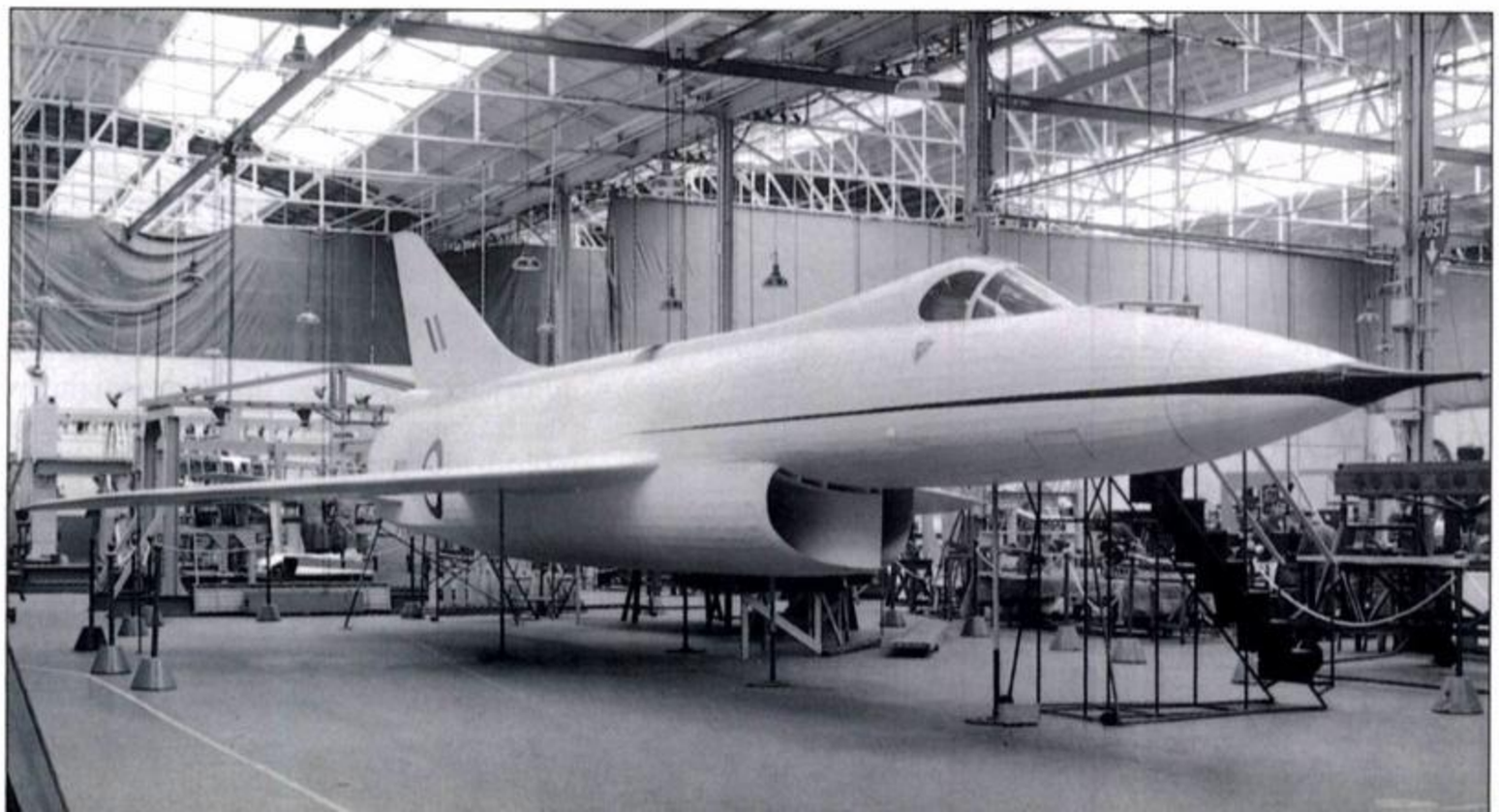
The story could begin by considering how accustomed we are to the way aircraft fly. If a sparrow had to run 100 times its own length in order to get airborne we would think this ridiculous, but we seldom stop to think that this is how aircraft take off. In fact, for civil transport aircraft long runways are at present the best answer, because nobody has been able to beat the seat/mile costs of the traditional aircraft. For military aircraft, however, to be unable to fly except from a long paved runway is ridiculous.

In World War II, the fact that every warplane required a traditional airfield was seldom a major problem. In 1944 the Luftwaffe followed USAAF B-17s to the Soviet airfield of Poltava and destroyed them by bombing, but there were plenty more B-17s. Likewise, on 1 January 1945 the Luftwaffe destroyed about 500 RAF and USAAF aircraft parked on front-line airfields, but they were quickly replaced. What changed everything was the development of the precision-attack missile with a nuclear warhead. This can wipe an airfield off the map, not only destroying the aircraft and infrastructure, but also killing the people and incidentally rendering the site unusable for a long period.

Thus, in 1955 veteran French aircraft designer Michel Wibault wondered if the 15 NATO nations might not be making a mistake of huge proportions by urgently constructing 100 new airfields along the frontiers between Germany and its Western neighbours. Called BOPs (basic operating platforms), each had a runway of thick white concrete 262 ft (80 m) wide and not less than 8,200 ft (2.5 km) long. Beside each one was a tall control tower stuffed with US-supplied electronics. Each BOP had many other facilities, for ordnance, fuel, maintenance and accommodation. Flying down the German frontier, one saw that these large and immovable bases were just far enough apart for their flying circuits not to pose the threat of mid-air collisions. As targets for nuclear missiles they were ideal. Accordingly, Wibault began thinking about warplanes with VTOL (vertical take-off and landing) capability, which could thus be dispersed away from such vulnerable bases.

Not a new idea

VTOL was far from being a new idea. Quite apart from auto gyros and helicopters, several VTOL aircraft were proposed in World War II, and increasingly the VTOL schemes were jets. The first to fly, in 1953, was the Rolls-Royce



At the time of the P.1127's gestation, Sir Sydney Camm was deeply concerned about the future of Hawker Aircraft Ltd. As production of the ageing Hunter wound down, the only new project on the horizon was P.1121, a private venture (seen here in mock-up form) to build an air superiority strike fighter with Mach 2.5 performance. Even though a contract for the aircraft did not exist, construction of a prototype began. It was finally abandoned in late 1958, when a customer failed to materialise. By then, the P.1127 design was proceeding apace.

Left: Three of the TES Kestrels formate for the camera. Almost 10 years of first flights, exhaustive testing and tri-national evaluation passed before the Hawker design entered service with the RAF, as the Harrier, in 1969. Ironically, it was the UK that had been the most reluctant to commit to the programme from day one.

'Bedstead'. More refined jet VTOLs were on drawing boards. One, the Short SC.1, was actually under construction, to meet British Ministry of Supply contract ER.143 for a 'flat rising' research aircraft with four turbojets pointing downwards for lift and one pointing aft for propulsion. Wibault hit on a way of making a completely novel 'flat riser' with one engine. He called it Le Gyroptère. He proposed a small fighter or attack aircraft with a powerful turboshaft engine (he suggested the Bristol BE.25 Orion, of 8,000 hp/5968 kW). Gearboxes took the shaft drive to four large centrifugal blowers, arranged like wheels, two on each side of the fuselage.

The novel bit was that the casing around each blower could direct the jets of compressed air vertically downward, evenly disposed around the aircraft's centre of gravity, to lift the aircraft vertically into the sky. The pilot could then slowly rotate these casings to direct the jets to the rear, accelerating the Gyroptère forward. As speed built up, the lift would be transferred to the wing, converting the odd hovering device into a jet aircraft. For landing, the procedure would be reversed.

Wibault spent the winter of 1955/56 discovering that the French government, and many Paris-based officials (including the management of Dassault), were not interested in his rather funny scheme. It was only when he approached the staff of the US-led MWDP (Mutual Weapons Development Program) that people began seriously to consider his idea. The head of the MWDP Paris office, Colonel Johnny Driscoll, USAF, had Wibault's scheme evaluated. This at once brought in AGARD (the NATO Advisory Group for Aeronautical Research and Development), whose chairman, the great Theodore von Karman, looked at Wibault's drawings and immediately exclaimed, "Ah, vectored thrust with a jet!" This was the key to everything that followed.

Bristol Aero-Engines

As nobody could fault the scheme, Driscoll decided to bring in an engine company. The obvious choice was Bristol Aero-Engines, because Wibault had suggested using a Bristol engine, and the main multi-national NATO aircraft, the Fiat G91, used the Bristol Orpheus turbojet. Accordingly, Driscoll sent Wibault's proposal to Dr Stanley Hooker, that company's chief engineer. Hooker had uneasily watched as rival Rolls-Royce (for whom he had previously worked for many years) acquired a monopoly position in British VTOL. Nobody knew if there would ever be a VTOL market, but Hooker wanted to 'get into the act'. Suddenly, here was a possible entry for Bristol, but he was not happy with Wibault's cumbersome arrangement of shafts and gears, which would be heavy and prone to failure.

These four Kestrels were among the nine built for the Tripartite Evaluation Squadron and flown by 10 pilots of three nationalities from five air arms. Of the latter, two (the RAF and USMC) became customers for the Harrier.

Hooker discussed the concept with Gordon Lewis, Pierre Young and Neville Quinn. A day or two later, on 2 August 1956, Lewis sent his boss a brief memo which set the company on the path that led to the Harrier. He replaced the shafts, gears and blowers with a single large axial compressor, driven via a reduction gear. He found that the first two compressor stages of the Olympus BO1.21 turbojet would be ideal, discharging through a swivelling pipe on each side. The resulting engine, far simpler and more compact, was called the BE.48.

A day or so later it was found that this concept could be further improved by replacing the complex and costly Orion with the simple and cheap Orpheus. This could be fitted with a new LP (low-pressure) turbine, driving a shaft passing through the centre of the existing Orpheus shaft, which by chance happened to be a large-diameter tube. By suitably selecting the LP turbine speed, this eliminated the need for a gearbox, though the LP and HP (high-pressure) compressors still had completely separate inlets and separate outlet systems. At a stroke, this made the engine lighter and more compact, and slightly more powerful and efficient.

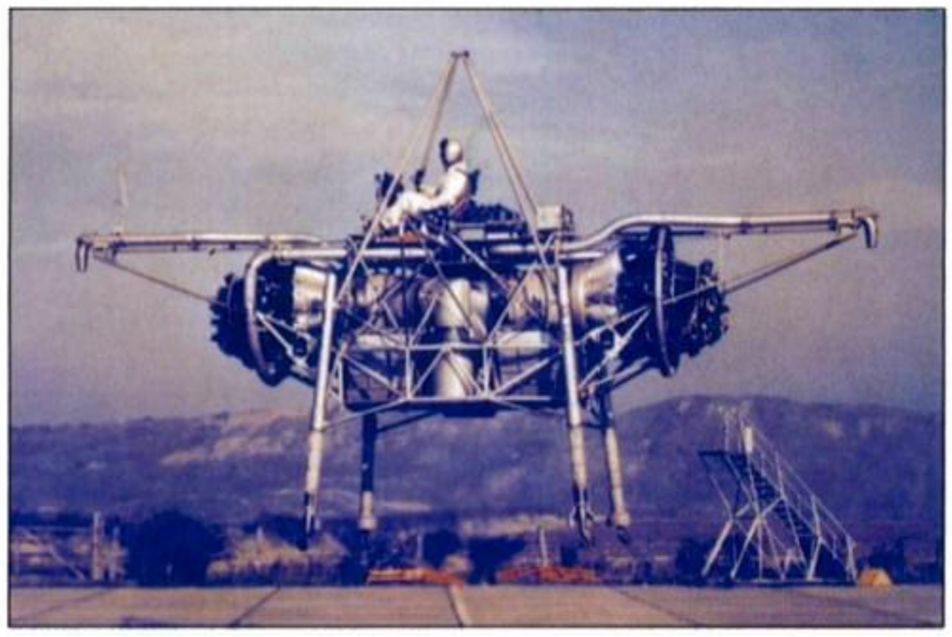
The fifth P.1127, XP980, prepares for another test flight in wintry conditions. As a potential Fiat G91 replacement (to NATO requirement NBMR-3 of 1961), the Hawker design was also known as VAK 191A. The only other NBMR-3 aircraft, of four proposed, to reach the hardware stage was the Fw 1262, built as the VFW-Fokker VAK 191B.

There was no reason why the hot core jet should not also be fitted with a 90° vectoring nozzle, and in fact the first patent drawing filed by Bristol for a vectored-thrust engine, dated 12 January 1957, depicted both vectored and fixed core nozzles as alternatives. Thrust (or lift) was estimated at about 8,000 lb (35.58 kN). The improved concept was called the BE.53.

The January 1957 patent suggested that the two spools (LP and HP) of the BE.53 engine should rotate in opposite directions. Normally, contra-rotation in a two-spool engine is not a matter of importance, but it was appreciated that any kind of Gyroptère would probably be a tiny aircraft containing a relatively large engine. When hovering, the gyroscopic couple of the rapidly rotating masses inside the engine would exert a very powerful force at 90° to whatever the pilot wanted, just like a toy gyroscope. For

Britain's first vertical risers

The first tentative steps towards a practical V/STOL aircraft were taken with the Rolls-Royce Thrust Measuring Rig (TMR), or 'Flying Bedstead' as it was more commonly known. With the possibility of commercial V/STOL applications in mind, two were built, the first (XJ314) 'flying' for the first time on 3 July 1953. Thrust came from two Nene turbojets mounted opposite each other, with boom-mounted 'puffer' jets – the forerunners of the reaction control jets fitted to the P.1127 family – keeping the rig on a level plane. A second aircraft, XK426, flew in 1957 and was allocated to the RAE. It made 157 tethered and four free flights before crashing fatally.



Above: The use of vertical lift jets for VTOL was explored with the Short SC.1. This delta-winged design used four RB.108 turbojets pointing downward, with a fifth pointing to the rear for forward propulsion, and featured a number of advanced systems for its day. These included an electronic control system, blind-flying datalink, a HUD, and an integrated reaction control system. The first of two prototypes, XG900, made its first transition from vertical to horizontal flight in April 1968, six months before the first flight of the first P.1127.

example, trying to pivot the aircraft about a vertical axis, to point to the right or left, would instead make the fuselage tilt nose-up or nose-down. This dangerous effect could be reduced or even eliminated by making the LP and HP spools rotate in opposite directions, and by making their rotational moment of inertia (a function of mass and rotational speed) as nearly equal as possible, so that they cancelled each other out.

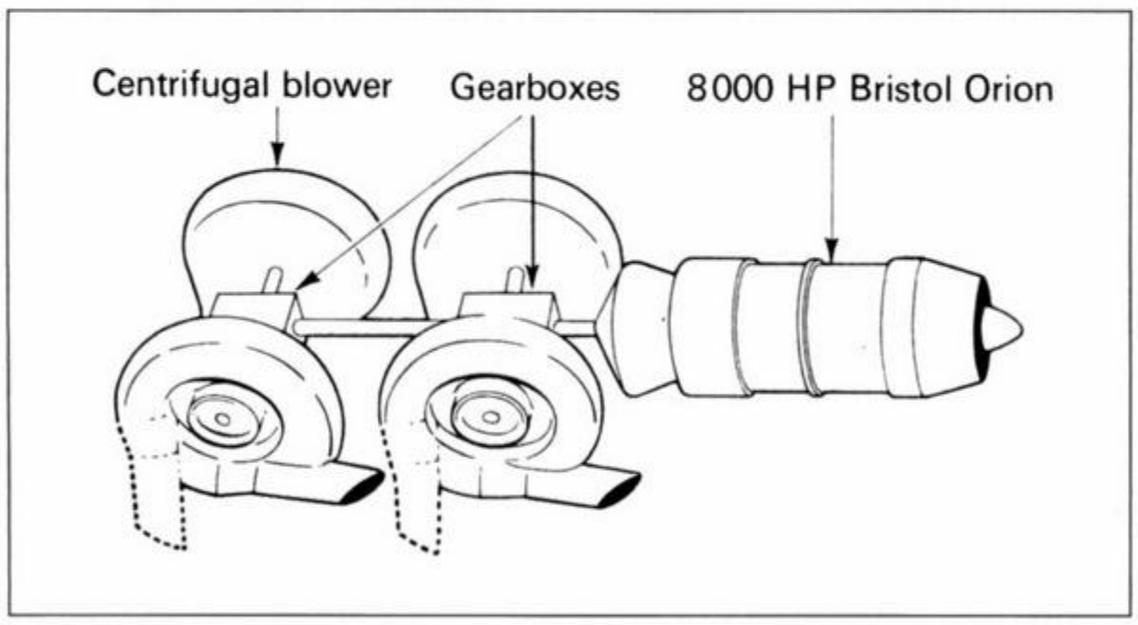
Hooker went to Paris, where Driscoll and von Karman were enthusiastic, saying, "Go ahead and design the BE.53." Bristol decided to do just that, hiring Wibault as a consultant and co-patentee of the idea with Lewis. Sadly, the elderly French designer lived only a few weeks longer, and never saw his novel idea come to fruition. In Paris, Driscoll was replaced by Colonel Willis Chapman, USAF, but fortunately Chapman was as enthusiastic as his predecessor. The only place where nobody was interested was in the British 'corridors of power', where the Minister of Defence, Duncan Sandys (pronounced 'sands'), was writing a White Paper on Defence which would announce the startling belief that the RAF would be 'unlikely to require' more fighters or bombers, as henceforth all missions would be flown by missiles!

At his office in Kingston, Sir Sydney Camm, technical director of Hawker Aircraft and architect of an unparalleled succession of famous RAF aircraft, had one big new project, the P.1121 Mach-2 fighter-bomber, the prototype of which was fast taking shape in the huge factory below. The trouble was, Hawker had no contract for the P.1121, which was being funded by the company in what appeared to be the obvious belief that such an aircraft would be needed. The Hunter was still in production, but was becoming obsolescent. To say Camm was worried about the future is an understatement. Although it seemed unbelievable, with each passing week official disinterest in a Hunter successor became ever more obvious.

Camm thought there might be some kind of future in VTOL, but found it hard to take the existing ideas seriously, because of their batteries of numerous special lift engines, which throughout most of a mission would be dead weight and bulk. In February 1957 he sent to Bristol a memo which read, "Dear Hooker, What are you doing about vertical take-off engines? Yours, Sydney." Hooker sent him the first brief BE.53 brochure, and then got on with Olympus work. In early March 1957 Camm telephoned him, asking, "When the devil are you coming to see me? I've got an aircraft for your BE.53."

First drawings

The next morning Hooker and Lewis were in Kingston, being shown the first three-view of the Hawker P.1127. It was a neat but very strange little machine, having the Bristol engine in the bottom of the fuselage, with the two cold nozzles aligned with the C of G and the single fixed hot nozzle pointing aft. Long main landing gears were fitted, so that on take-off the engine would be tilted at about 30° to the



Above: To power his Gyroptère of March 1956, Wibault proposed this arrangement, whereby a powerful gas turbine (in this case a Bristol Orion) drove four high-capacity blowers. These could be vectored to provide lift or thrust. Though interested, Stanley Hooker took the view that such a design was unnecessarily heavy and potentially unreliable.

PERFORMANCE AND AERODYNAMICS DEPARTMENT — 2nd August, 1956

G.N. 1616

To: Dr. Hooker

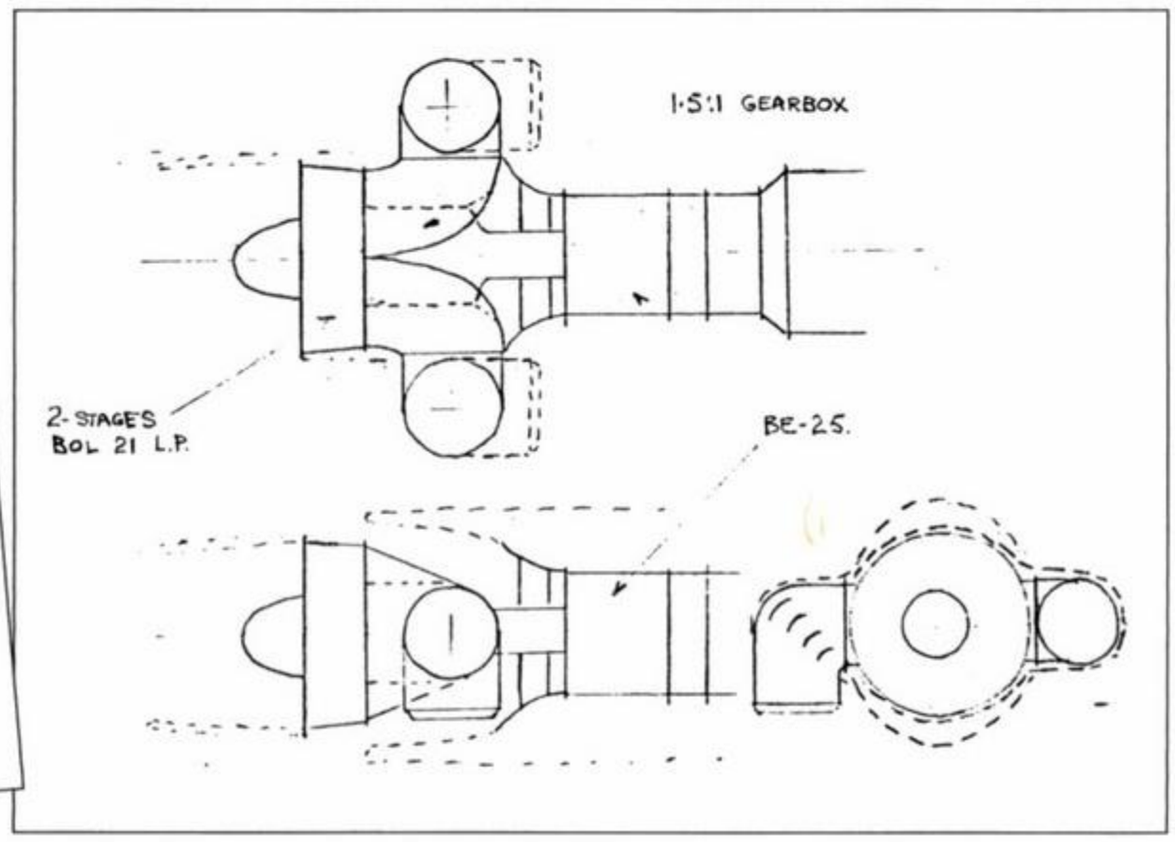
GYROPTER PROJECT

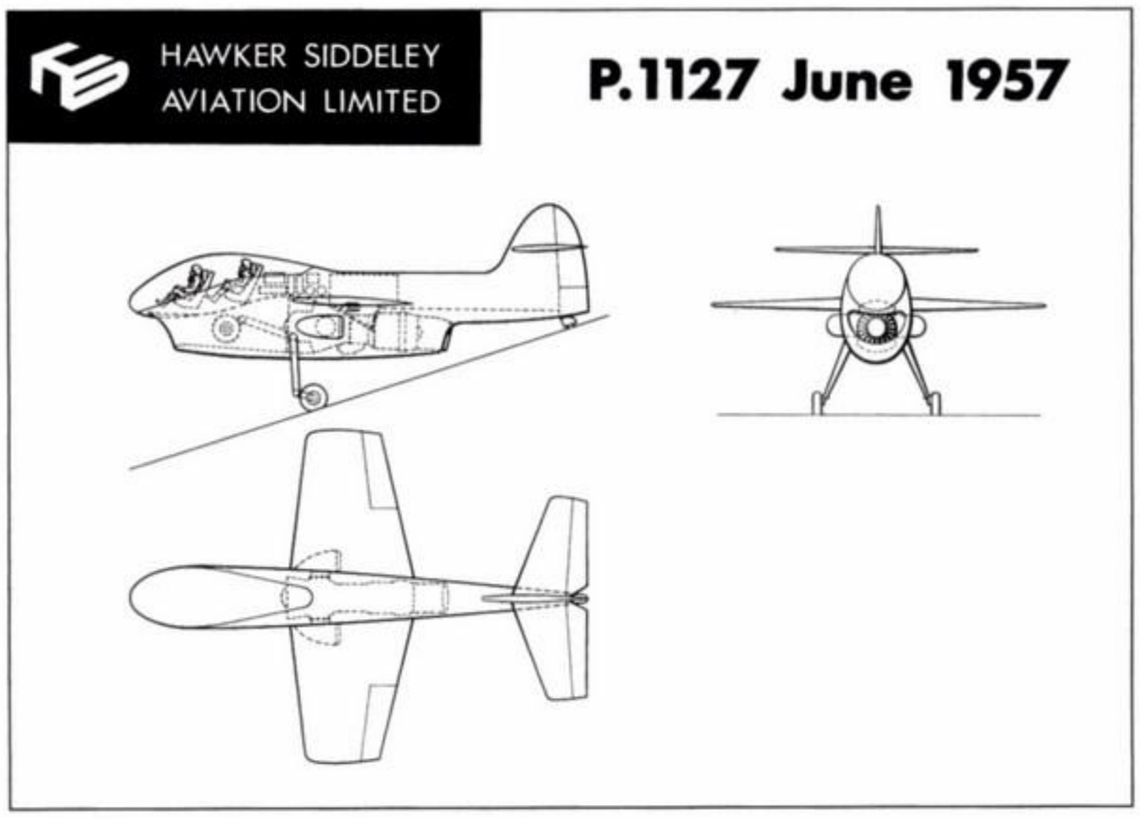
A brief study of the Wibault report entitled "Ground Attack Gyropter" indicates that the weight assumed for 4 large centrifugal compressors and bevel drive gear boxes (1080 lbs) is very optimistic. The layout shown on the attached sheet would appear to have the following characteristics:

(a) Lighter and within Wibault's assumed weight
(b) Closely similar performance
(c) Utilises a compressor under development
(d) Easier to install
(e) Cheaper
(f) Easier to control

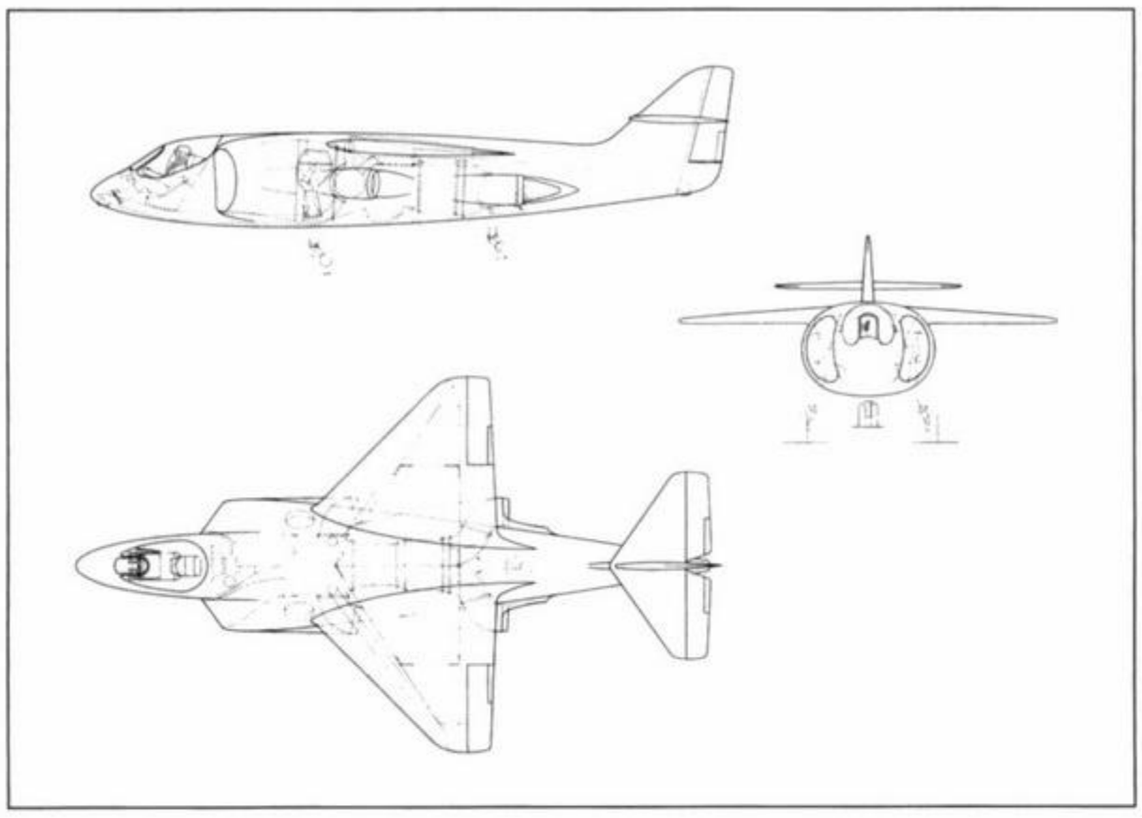
G.M. Lewis

Below: This sketch by Bristol's Gordon Lewis of his BE.48 proposal was accompanied by a memo (below left) dated 2 August 1956, outlining the advantages of his design over Wibault's proposal. This "simple and elegant way of doing what Wibault was trying to do", as Lewis described it, replaced the centrifugal blowers and a single axial compressor with a pair of rotating nozzles and a single rear deflecting jet pipe. Early P.1127 designs around this engine were not promising, Hawker persuading Bristol to adopt a 'four poster' arrangement with twin nozzles (the BE.53) the following year. Thus, the transition from the Gyroptère to an aircraft recognisable as a member of the Harrier family had been completed.





The first P.1127 prepared in March 1957 was followed by this slightly more detailed version in June. Note the two cold nozzles beneath the wing and the single hot nozzle to the rear. For take-off, the engine would have tilted 30°. The design was of limited practical use, other than for research.



Pressure from Hawker resulted in the 'four-poster' layout whereby thrust and lift came from two pairs of nozzles operating in unison. This was adopted in this later incarnation of P.1127 – a design that was beginning to resemble the aircraft that was eventually built and flown.

ground, giving a small lift component from the core nozzle. As a research aircraft it seemed interesting, but it clearly was not going to be very fast, nor carry a heavy load. It seemed poles apart from the far more powerful P.1121. However, the Bristol men were impressed by young designers Ralph Hooper (who had actually drawn the P.1127) and the man who shared his office, John Fozard, the P.1121 project engineer. They explained that, as there seemed to be no interest in combat aircraft, Hawker envisaged the P.1127 as being a three-seat liaison aircraft able to nip about anywhere over a land battle, carrying senior officers and perhaps cameras and a few light weapons.

On 4 April 1957 Duncan Sandys presented his famous – or rather infamous – White Paper. It did indeed say that the RAF would be unlikely to need any more fighters or bombers, and one of the many projects torn up as a result was the P.1121. The effects of this document have been felt by both the RAF and the British aircraft industry right up to the present time.

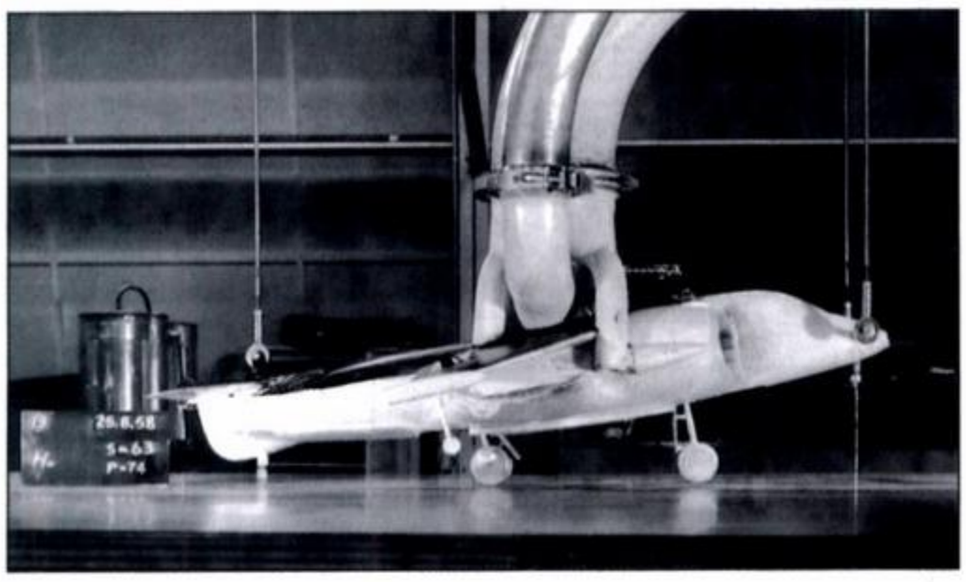
A week later, a modified P.1127 drawing appeared. At first the Hawker designers had not even believed the idea of an Orpheus-based engine giving 8,000 lb (35.58 kN) of thrust. Now they believed it, but only part of this thrust was available for lift. More detailed calculations had shown that the P.1127 would have to be only a two-seater, and that engine performance would be improved if lateral inlets were used instead of a long duct from the nose. The aircraft still looked ungainly, and nobody liked the excessive ground angle. Meanwhile, at Bristol, a third stage was added to the Olympus compressor, or fan, which was entirely overhung ahead of the front bearing. By this time, calculated thrust had been increased to over 9,000 lb (40.03 kN).

Bifurcated jetpipe

At about this time, in June 1957, Fozard suddenly recalled the bifurcated jetpipe of the Hawker Seahawk. Fitting a bifurcated pipe to the BE.53 core would enable the engine to have four side nozzles, all with vectoring. This would facilitate the achievement of VTOL. That nobody thought of making a 'three-poster' engine with full vectoring is surprising, because both before and since that time various jet engines have had single vectored main nozzles. Be that as it may, by June 1957 Bristol had turned the BE.53 into a 'four-poster' engine. The two front nozzles put out compressed fan air, and the rear nozzles vectored the hot core jet. Of course, all four nozzles had to swivel in unison.

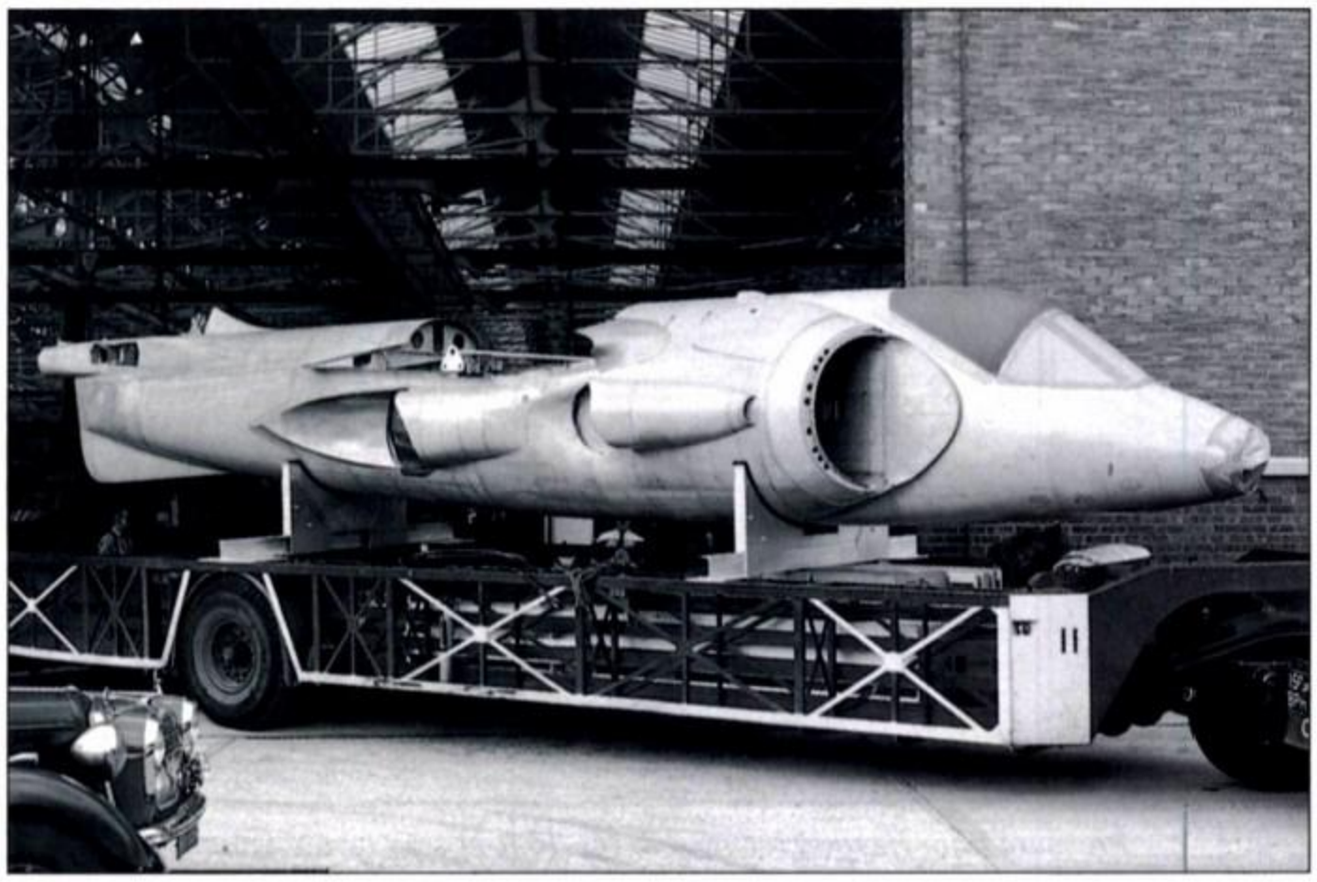
All that had to be done was put the revised BE.53 in the centre of a modified P.1127, with the nozzles evenly disposed ahead of and behind the aircraft C of G. By this time, with estimated thrust being coaxed beyond 10,000 lb (44.48 kN), the Kingston engineers began to consider the P.1127 as possibly a real combat aircraft, with a single-seat cockpit and an airframe designed for 3,000 hours at an ultimate load factor of 12.

The revised P.1127 was schemed for Mach 0.95, so the fuselage was better profiled, the vertical tail was slightly swept, and the wing and horizontal tail were tapered sharply on the leading edge, to give a blunt-tipped delta shape. There was no longer any need for a steep ground angle, so the landing gears could all be



Above: This P.1127 model, seen in August 1958, sucked air through its intakes and blew air from the four engine nozzles to allow research into the likelihood and characteristics of ground effect in the V/STOL design.

Right: Before being shipped to Dunsfold for final assembly, a trials fitting of a BE.53 engine was made to ensure all was well. XP831, the first P.1127, is seen here at Richmond Road, Kingston during this delicate procedure, with at least a dozen engineers looking on.



Above: For engine runs prior to hover and flight tests, this shroud was constructed as a noise abatement measure. Seen here fitted around XP831, it was abandoned after catching fire!

Left: Positioned in a jig aboard a 'Queen Mary' trailer unit, the airframe of XP831 leaves Hawker's Kingston factory en route to Dunsfold for final assembly and flight testing.

short. At this time, the arrangement was to have two main wheels, retracting under the front nozzles, and a twin tailwheel.

One annoying fact, which appeared to be impossible to circumvent, was that with a conventional aircraft layout – and nobody wanted to add any more radical features – the wing had to be above the engine. This not only slightly affected engine performance in hovering flight but also meant that, to change the engine, it was necessary first to remove the wing.

Hawker had already spent over £1 million, then an awesome sum for a private firm, trying to get the P.1121 off the ground. After the 'Sandystorm' of April 1957 there seemed to be nothing in sight except a desire by the Air Staff to formulate a requirement for an aircraft to replace the Canberra. Later, this took shape as OR.339, and Kingston joined forces with Avro to propose the P.1129, derived from the P.1121. (Hawker Siddeley did not win this requirement, which eventually led to the TSR.2, cancelled in 1965.) In November 1957 priority on the P.1129 took nearly all the available design engineers released by termination of the P.1121, so work on the P.1127 temporarily had to be shelved.

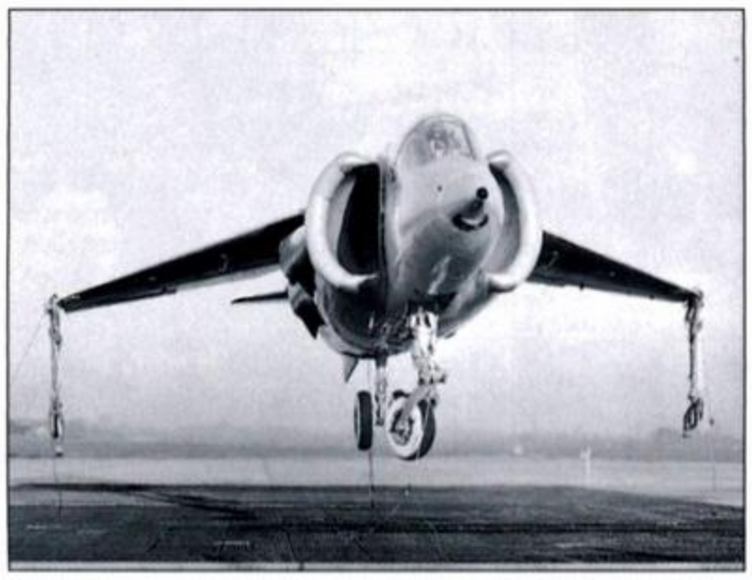
Thus, the quaint VTOL concept was initially taken lightly. It was to some degree a case of 'any old port in a storm', especially a Sandystorm, and, as the costs looked like being relatively modest, Camm proposed that the firm should risk its own money building a P.1127. The Hawker Siddeley board agreed to vote funds to pursue the project, though it stopped short of financing prototypes. Back in 1936 the same board had taken the momentous decision to vote funds to build 1,000 Hurricanes, but that was in the sure knowledge that they would be needed. In 1958 there was no certainty about anything.

"Not one man-hour"

To illustrate how Sandys' beliefs had affected all the top people in the Ministry of Supply and RAF, the author was proudly told by the Director of Operational Requirements that "not one man-hour" had been, or would be, devoted to assessing the operational potential of a P.1127. The Deputy Controller of Aircraft R&D, Dr Walter Cawood, said, "There is no chance of Hawker receiving any kind of contract for the P.1127, as it appears to have no civil potential."

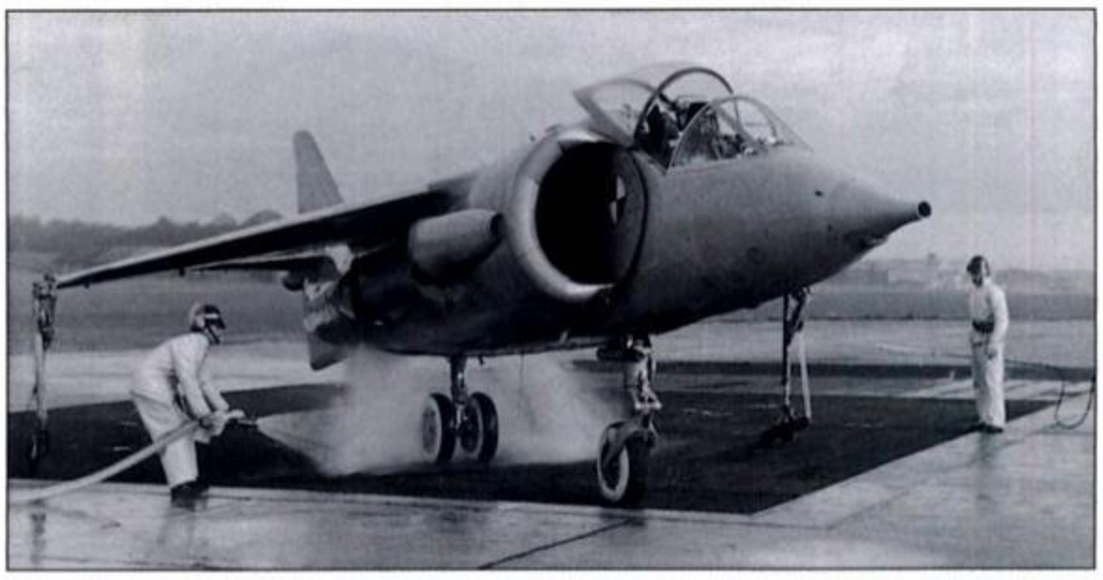
The only bright spark on the horizon was that in the USA the decision-takers had not taken leave of their senses. The MWDP staff became increasingly enthusiastic about the unbelievable simplicity of the Bristol/Hawker single-engined VTOL, and in early 1958 Bristol was informed that American support would be forthcoming. In June 1958 an agreement was reached similar to that for the Orpheus:

Below: Despite making the first hovers over a grid-covered pit which directed the jet efflux away from the aircraft, the efflux caused the aircraft's tyres to overheat. White paint was applied in an attempt to keep them cool, but the attentions of a fireman were still necessary between hovers.



Above: Bill Bedford gingerly hovers XP831 sometime during October or November 1960. The crudely fitted dampers on the outrigger wheels provided extra stability during the tentative, and often far from stable, first hovers.

Left: In this view, the prominent 'bell mouth' intakes are clearly evident. The increased intake lip radius improved air flow in hovering flight.



Right: Colour views of the first P.1127 hovering at Dunsfold are rare. This example reputedly shows the first untethered flight on 19 November 1960.

Below: Bill Bedford, in characteristic pose, rests between test flights. Note that the aircraft's nose instrumentation boom has been refitted. This and other items – including the undercarriage doors, airbrake, radios and ram air turbine – were removed to save weight during the first hovers.

MWDP would fund 75 per cent of the BE.53's development cost and Bristol the rest. Even though at the time there was no obvious customer, Bristol's Sir Reginald Verdon Smith never hesitated, and the money the company put into the BE.53 ultimately proved to be one of its best investments.

Thus, in June 1958 actual design of the BE.53 could go ahead. By this time it was clear that the engine had to be more than an Orpheus with an added LP spool based on the Olympus compressor. Under Charles Marchant, a totally refined BE.53, soon named Pegasus, took shape. It was obvious that even a thrust of 11,000 lb (48.92 kN) would be inadequate, and design went ahead for 13,500 lb (60.04 kN). The LP compressor was modified into a two-stage fan, with transonic blading, with a single inlet. Thus, the air passing through the outer part escaped through the front nozzles, while that passing through the inner part went straight to supercharge the HP compressor. Overall engine pressure ratio was increased, improving power and efficiency. Not only was the whole fan overhung ahead of the front bearing but there were no inlet guide vanes, thus pioneering the way turbofans are designed today.

Mirror-image blading

Mirror-image blading made the fan rotate in opposition to the HP spool. The bypass ratio was set at about 1.35; in other words, the airflow discharged by the fan was 1.35 times the flow of hot gas through the rear nozzles downstream of the core engine. This was so that thrust from the front and rear nozzles should be equal, the hot jets having a higher velocity (1,800 ft/sec; 549 m/sec) than the cold ones (1,170 ft/sec; 357 m/sec).

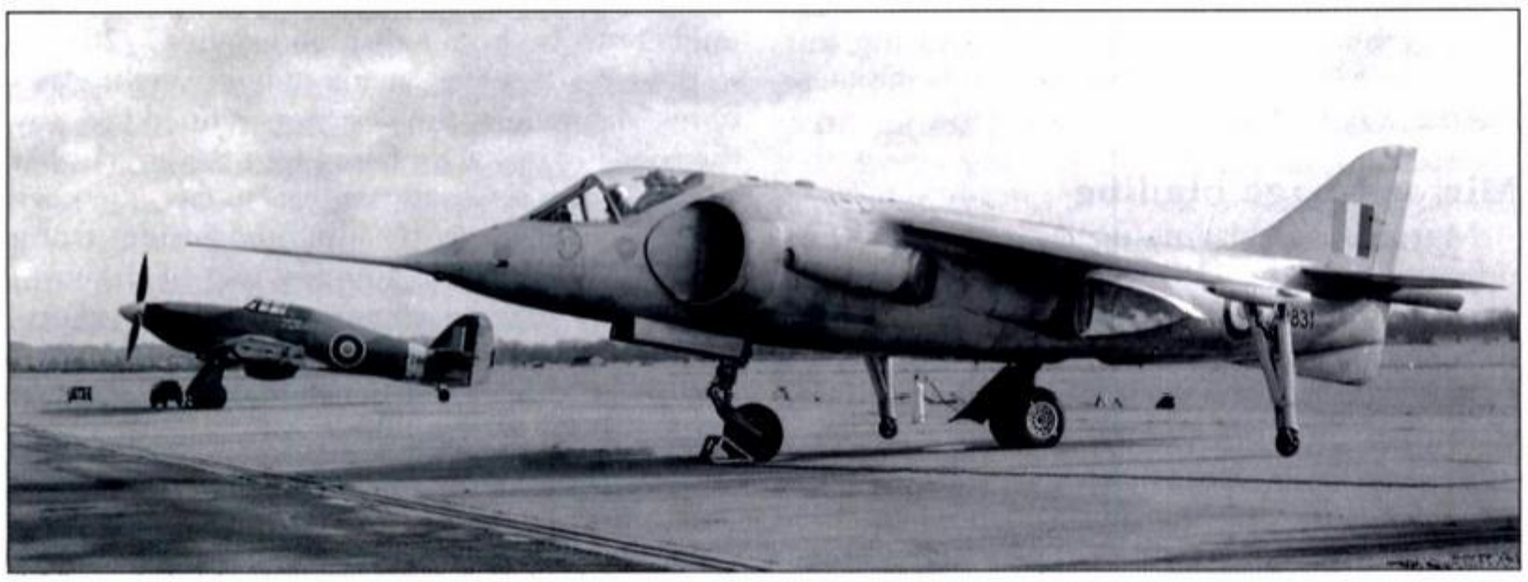
Everything possible was done to save weight and improve the engine's aerodynamics. For example, the original idea of bent-pipe nozzles was replaced by carefully profiled nozzles with internal cascade vanes to guide the flow round the 90° corner. As the core nozzles would handle gas at about 650°C (1,202°F) there was no alternative to making them of Nimonic alloy, but the air passing through the front nozzles was unlikely to be hotter than about 95°C (203°F), so these nozzles were made of lightweight glass-fibre. Meanwhile, the designers refined the way the four nozzles were faired into the aircraft. At an early stage it was found that, in fact, the nozzles would have to be mounted inside strong gas-tight ball bearings forming part of the fuselage. To change an engine, it would be necessary to disconnect the nozzles. Downstream of the rear nozzles were pen-nib fairings to keep the hot gas away from the rear fuselage.

Hawker P.1127

1 Pitot head
2 Yaw and pitch vanes
3 Instrumentation boom
4 Nose pitch control reaction air nozzle
5 Dynamic pressure probe
6 Tailplane spring feel unit and trim actuator
7 Rudder pedals
8 Control column and linkages
9 Shrouded instrument panel
10 Engine throttle and nozzle angle control levers
11 Martin-Baker Mk 4 ejection seat
12 Aft-sliding canopy
13 Intake inflatable 'bell-mouth', temporarily fitted for recirculation flow tests
14 Boundary layer splitter plate
15 Nosewheel hydraulic retraction jack
16 Levered suspension nosewheel, forward-retracting
17 Port air intake
18 Lower VHF communications antenna
19 Intake flank fuel tank
20 Bristol-Siddeley BE.53/2 turbofan engine
21 Engine oil tank
22 Twin alternators
23 Upper VHF communications antenna
24 Engine accessory equipment gearbox
25 Alternator cooling air ducts
26 Engine forward (fan air) swivelling nozzles
27 Engine bay flank fuel tanks
28 Hydraulic reservoir
29 Rear nozzle bearing cooling air ducts
30 Engine turbine section
31 Wing integral fuel tank
32 Starboard outrigger wheel
33 Reaction control air ducting
34 Starboard navigation light
35 Roll control reaction air nozzle
36 Starboard aileron
37 Starboard plain flap
38 Flap hydraulic actuator and torque shaft
39 Rear fuselage fuel tank
40 Emergency ram-air turbine
41 Stand-by VHF antenna
42 Rudder control linkage, cable driven
43 Starboard all-moving tailplane
44 UHF antenna
45 Rudder
46 Rudder trim tab
47 Yaw control reaction air valves, nozzles port and starboard
48 Aft pitch control reaction air valve
49 Anti-spin parachute housing
50 Port all-moving tailplane
51 Tail bumper
52 Tailplane hydraulic actuator
53 Tailplane control linkage, cable driven
54 Aft reaction control air ducting
55 Exhaust nozzle heat shroud
56 Engine rear (hot-stream) swivelling exhaust nozzle
57 Port plain flap
58 Aileron hydraulic actuator
59 Aileron to reaction air nozzle interconnecting linkage
60 Port aileron
61 Outrigger wheel, retracted position
62 Port outrigger wheel strut
63 Castoring outrigger wheel
64 Hydraulic retraction jack
65 Port roll control reaction air nozzle
66 Port navigation light
67 Leading-edge reaction air ducting
68 Twin mainwheels, aft-retracting
69 Mainwheel door, functions as airbrake

Pegasus testbed

The first production Valiant B.Mk 1 (WP199) was chosen to act as a flying testbed for the Pegasus 3, Bristol Siddeley having concluded that a flying testbed would be useful as a means of solving some of the engine's persistent problems – surging, in particular. The V-bomber flew for the first time in this condition on 11 March 1963, but on its third flight the installation disintegrated, delaying the test programme by three months. With the engine installed in the bomb bay, ground clearance was minimal. FOD ingestion (from the Valiant's avionics bay) and the less than realistic installation led to a premature end to the testbed programme, after 50 of the planned 70 flights had been completed.



Hawker's chase aircraft for XP831's first untethered flights was the then-company-owned final production Hurricane Mk II, PZ865* The Last of the Many. *The P.1127 prototype had made its first transition from vertical to horizontal flight on 12 September 1961 and then explored the lower end of the performance envelope (up to 90 kt; 166 km/h), accompanied by the Hurricane.

Engine director Hooker was well aware that it would be essential for all four nozzles to vector together in unison, and stop in precisely each angular position the pilot commanded. Wondering how to achieve this, he recalled that for many years he had not seen a broken motorcycle drive chain. Accordingly, the nozzles were arranged to be chain-driven by a motor unit quickly developed by Plessey. This comprised two air motors driving via a differential. Failure or jamming of either input would leave the other motor driving the nozzles at half speed.

Worried about the 650°C (1,202°F) gas passing through the rear nozzles (high enough for metal to become dull cherry-red), the Bristol engineers were delighted to calculate that the fan air would always be delivered at a pressure slightly higher than that of the hot jetpipe gas. Accordingly, all they had to do was run a small pipe from the LP plenum chamber to volute casings round the rear-nozzle bearings to keep the hot gas at bay, making life easier for the surrounding ball bearings.

Prolonged flight development

Even so, it was obvious that there would have to be a long period of flight development because of all the variables, most of which had never before been encountered. These included considering the effect of the violent air and hot gas flow all round the aircraft on the ground, or when hovering at low altitude. Another problem was the loss in thrust, and possibly dangerous increase in turbine temperature, caused by the engine reingesting its own hot gas instead of fresh air. Another problem was the need to match thrust from the front and rear nozzles even when the four nozzles vectored (rotated) through at least a right angle. It was later discovered that nozzle movement could not be less than 98.5° in order to use engine thrust effectively in a nose-down attitude, and also to act as a powerful brake to bring the aircraft quickly to the hover.

Back in 1956 Lewis had pointed out that any VTOL aircraft has to have a powerful flight-control system able to operate in hovering flight, when ordinary control surfaces are useless. This was immediately appreciated by the Hawker designers, who accordingly began to scheme what were soon called 'puffer jets' under the nose, tail and wingtips, fed by HP air from the Pegasus combustion chamber.

Once actual design of the BE.53 had begun, Marchant had to liaise with the Kingston engineers to determine in more detail how the inlets would be arranged and how the nozzles would be faired into the fuselage. Things were obviously going to be difficult in the hover, where the background of established knowledge was approximately zero. Even in high-speed wing-borne flight, the fact that all four jets would scrub along the sides of the fuselage posed a completely new set of problems. In addition, powerful forces would be imparted to the hovering aircraft by the large airflow being sucked into the inlets.

By August 1958 results were coming in from a unique model which examined the flow patterns round a P.1127 hovering at low level, with air being sucked into the inlets, cool air discharged from the front nozzles and hot gas from the rear nozzles. The forces on the model could be measured. It was found that, close to the ground, the jets blasting on the ground gave rise to what were called 'fountains' – high-speed rising columns of air or gas which impinged on the underside of the fuselage to

XP831 makes a low-level, high-speed pass over Dunsfold, evidently sometime prior to its crash in 1963, as it still has the shorter tailfin.

XP972, by then carrying tri-national markings, hovers for the assembled crowds at the 1962 SBAC air show (with No. 74 Squadron Lightnings and No. 92 Squadron Hunter display aircraft in the background). In November '972 crashed and was written-off at Tangmere. XP831 was also present at Farnborough, though it too came to grief, at the following year's Paris Air Salon.

add lift. On the other hand, the much larger spreading-out of the jets under the wing was found to cause a pumping or suckdown action which tended to pull the aircraft towards the ground, in effect adding at least 10 per cent to the apparent weight. Ways were studied of adding movable LIDs or CADs (lift-improvement or cushion-augmentation devices) under the aircraft.

In the same month – August 1958 – the Hawker board sanctioned the first go-ahead on actual design, but restricted it to the P.1127 wing. Funds were provided for manufacture and test of two wings. In Paris the MWDP not only assisted with funds but also found support among the NATO air forces for the concept of a jet VTOL tactical attack/fighter to replace the Fiat G91. A few weeks later the British Air Staff privately dared to begin considering a specification (Operational Requirement) for such an aircraft, even though this was contrary to the 'no more manned aircraft' policy.

Refining the design

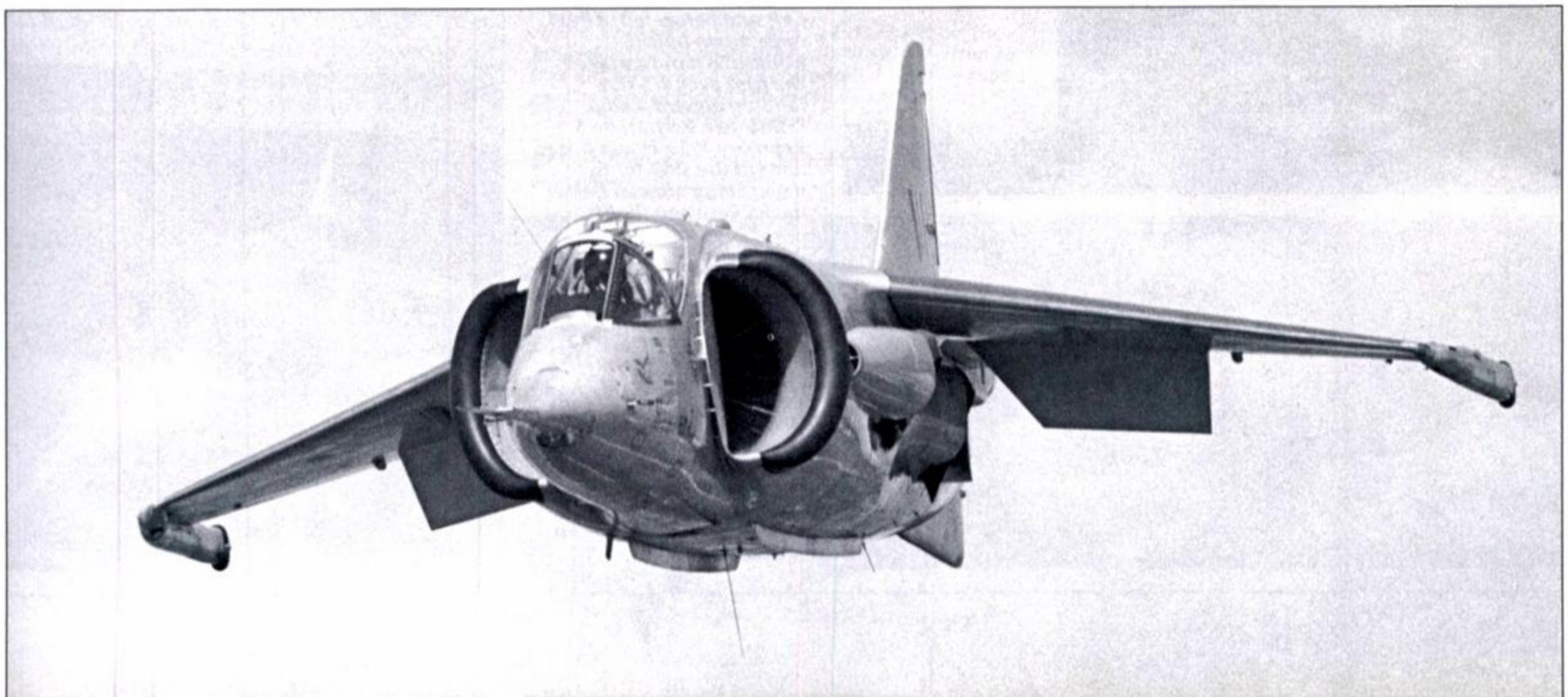
During the rest of 1958 the engineers at Bristol and Kingston refined the strange aircraft and its engine, and began the actual process of manufacture. One of the points over which there was much argument concerned the pilot's controls. Many thought that for hovering flight the P.1127 should have a helicopter-type collective lever, with a rotary throttle twist-grip on the end. The next idea was to use a conventional throttle working in a kind of ratchet box with a hydraulic dashpot and spring. To go from lift to thrust the hydraulic valve was shut, whereupon the spring slowly rotated the nozzles so that after about 30 seconds they were pointing to the rear. To go from forward flight to the hover the pilot moved the throttle to the rear; with the hydraulic valve open, the spring immediately rotated the nozzles down for hovering flight.

In January 1959 Hawker Aircraft was visited by the Deputy Chief of the Air Staff (Operational Requirements), W. H. (later Sir Wallace) Kyle. He delighted Camm and his team by announcing that the Air Staff was privately thinking in terms of something like the P.1127 as a replacement for the Hunter in the tactical attack fighter role. This obviously implied a total reversal of official policy, and the air marshal made it clear that, though the RAF knew what it wanted, it had to tread carefully because officially aircraft were forbidden.

On the NATO front, the idea of VTOL had taken air forces by storm. Already Rolls-Royce was captivated by the possibility of future warplanes with up to 16 lift engines each, and was urgently designing the RB.162 for several projected aircraft, starting with the Dassault Mirage III-V, each of which would have eight, installed vertically. Hawker Aircraft was told that it would help if they collaborated with a continental aircraft firm in order to make the P.1127 an international project, but decided against

Right: XP831 kicks up a dramatic cloud of spray as it lands vertically at the 1962 Farnborough show. Earlier in the year the aircraft has been fitted with the black inflatable intake lip 'bags'. These could be inflated when required (i.e., in the hover) to improve inlet airflow, and otherwise lay flat against the intake. However, they tended to be torn off at high speed and were eventually abandoned.

Below: Despite appearances, XP831 is actually hovering in this photograph, its intake 'bags' inflated.



The first, fourth and fifth P.1127s are seen here sometime after late 1964, possibly over Dunsfold. Discernible are the taller fin and anhedral tailplane fitted to the nearest machine (XP980) and retrofitted to XP831 (centre) after its 1963 mishap. XP980's mainplane also sports vortex generators and simplified wingtips.

doing so. Camm saw that the P.1127 was merely a proof-of-concept article, to be got into the air as quickly as possible. There was every hope it would in turn lead to a much more powerful supersonic successor. This next-generation aircraft might well be developed with one or more partners, as is now being done, 40 years later, with the JSF.

Operational Requirement 345

In April 1959 Hawker received a welcome document: OR.345, a draft Operational Requirement. This outlined a kind of upgraded P.1127, with an engine rated at 18,500 lb (82.3 kN). There was at this time a sense of utter confusion in the Air Staff, which percolated down throughout the RAF. About half the senior staff had never subscribed to the Sandys doctrine, and by 1959 were beginning to think that perhaps they dare say so. The rest were interested in their careers, and were determined to toe the government line even if they had never actually believed it.

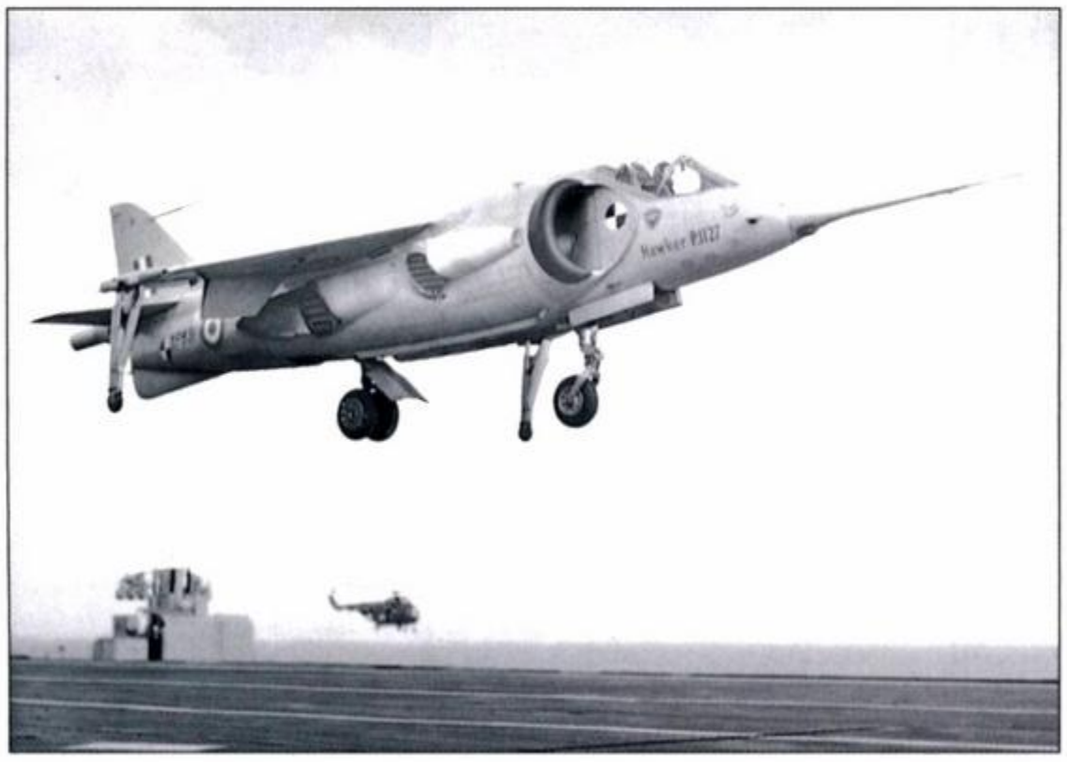
In May 1959 the Ministry of Supply issued draft specification ER.204D (ER, Experimental Research) to cover the proposed purchase of two P.1127s, which received serial numbers XP831 and XP836. From this point, even in advance of contract cover, it was 'all systems go' at Hawker Aircraft. Thanks to Colonel Chapman's interest, an increasing stream of Americans came to Kingston to be briefed on this strange aircraft, the first VTOL flat-riser to have a single engine. They were especially intrigued by the fact that, though a small research machine, it was being designed to the same limits as the Hunter. These included a life of 3,000 hours, EAS (equivalent airspeed) of 620 kt (713 mph; 1,147 km/h), and ultimate loading of 8*g* with a factor of 1.5. The Mach limit was set at 1.0, but in fact it was found that in long dives this could be exceeded by a wide margin. In level flight the modest jet velocity kept Mach number below about 0.95.

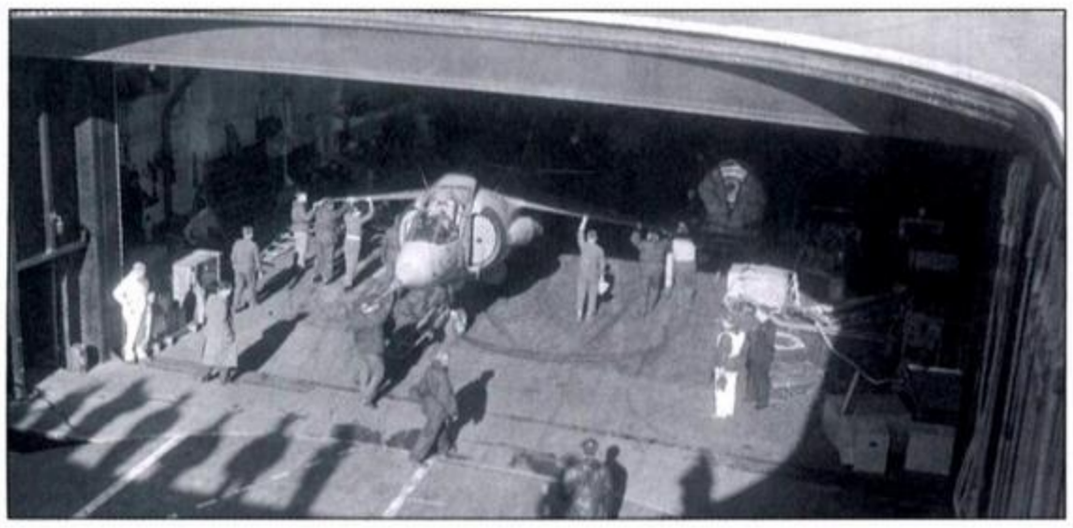
The first complete Pegasus was started on the testbench in August 1959. Though it behaved very well, even in slam accelerations, it was soon obvious that the maximum thrust was well short of the design figure of 13,500 lb (60.04 kN). Hooker was forced to advise Camm that, at least for early P.1127 testing, he should consider maximum thrust to be 11,000 lb (48.92 kN). The result was a predictable explosion; Camm professed to have been let down by engine designers all his life. It was only with difficulty that Hawker managed to keep the loaded weight of the first P.1127 below 11,000 lb (4989 kg).

Led by John Dale, the Pegasus team kept modifying the design, and in March 1960 the maximum thrust had been coaxed to 11,500 lb (51.2 kN). On the other hand, the bleed-air requirement for the P.1127 reaction-jet control system had increased, so Camm was finally given an available figure of 11,000 lb, cleared for 15 hours of VTOL tests. This enabled the P.1127 to lift chief test pilot A. W. 'Bill' Bedford and 35 Imp gal (159 litres) of fuel, just enough for two minutes of hovering.

XP831 was built at Kingston in the first half of 1960. Features included an extremely small wing with anhedral, tapered on the leading edge, mounted in the top of the fuselage, and fitted with ailerons and plain flaps. The tailplane was a slab, without separate elevators, mounted horizontally, and a small ventral fin was added

V/STOL at sea





Left and below left: XP831, once again in Bill Bedford's hands, makes the first ever V/STOL landing aboard a ship (HMS Ark Royal), on 3 February 1963. It was based aboard the ship for five days, being stowed below decks between flights.

Above and right: Three years later XP984, built close to Kestrel standard with a Pegasus 5 engine and other changes, was involved in trials aboard HMS Bulwark in the English Channel in June 1966 after the fitting of a Harrier-type wing. The next sea trials did not take place until 1969, when a Harrier GR.Mk 1 of No. 3 Squadron, RAF flew from the same vessel.

Mishaps

Below: XP972 was barely six months old when Hugh Merewether made an emergency landing at RAF Tangmere after an engine main bearing failed and the engine caught fire. Merewether had been attempting a high-g turn and, though he had attempted a forced landing, was unable to prevent the aircraft's undercarriage collapsing. It was trucked to Kingston and, after sale to a German company in 1963 fell through, was cut up for scrap.

Above: Having had its public debut at the RAF Upavon 50th anniversary display exactly 12 months earlier, XP831 (with Bill Bedford at the controls) came to grief at the Paris Air Salon on 16 June 1963, before a crowd numbering over 100,000. A speck of grit had jammed the servo to the nozzle drive system while Bedford was manoeuvring in the hover, resulting in a loss of lift and a heavy landing. The second P.1127, XP836, also crashed after one of its cold nozzles blew off in flight. Bedford ejected to safety, but the aircraft was a write-off.

under the rear fuselage. The relatively huge engine inlets were temporarily fitted with extensions with a generous lip radius to improve breathing in hovering flight. The landing gears comprised a rearward-retracting twin-wheel main unit just behind the C of G, a steerable nose unit which retracted forward, and long stabilising legs under the wingtips which retracted backward, the wheels laying far behind the trailing edge.

For control in hovering flight, a fixed bleed of 12 lb (5.4 kg)/sec of HP air from the combustion chamber was taken through Nimonic pipes to 'puffer jets' in the form of convergent nozzles pointing downwards, each closed by a swinging shutter under the pilot's control. Each gave about 1,000 lb (4.45 kN) of thrust. The wingtip jets provided roll control. The nose and tail pitch jets could be swivelled left/right to control yaw. Apart from that in the nose, which was directly connected to the stick, the 'puffer jets' were interlinked with the associated flight-control surfaces, driven by tandem hydraulic power units. Emergency hydraulic power could be provided by a ram-air turbine extended ahead of the fin.

Hugh Conway of Shorts insisted that complex three-channel auto-stabilisation would be needed, but true to form Camm said (only half-jokingly), "We're ignorant buggers, we don't understand all that stuff," and provided only the pitch and roll channels with a simple single-lane auto-stabiliser. The cockpit was simple, not unlike a Hunter except for the addition of the strange engine/nozzle controls. The canopy slid to the rear, climbing back on inclined rails, and the seat was a Martin-Baker H.6.

Engine/airframe integration

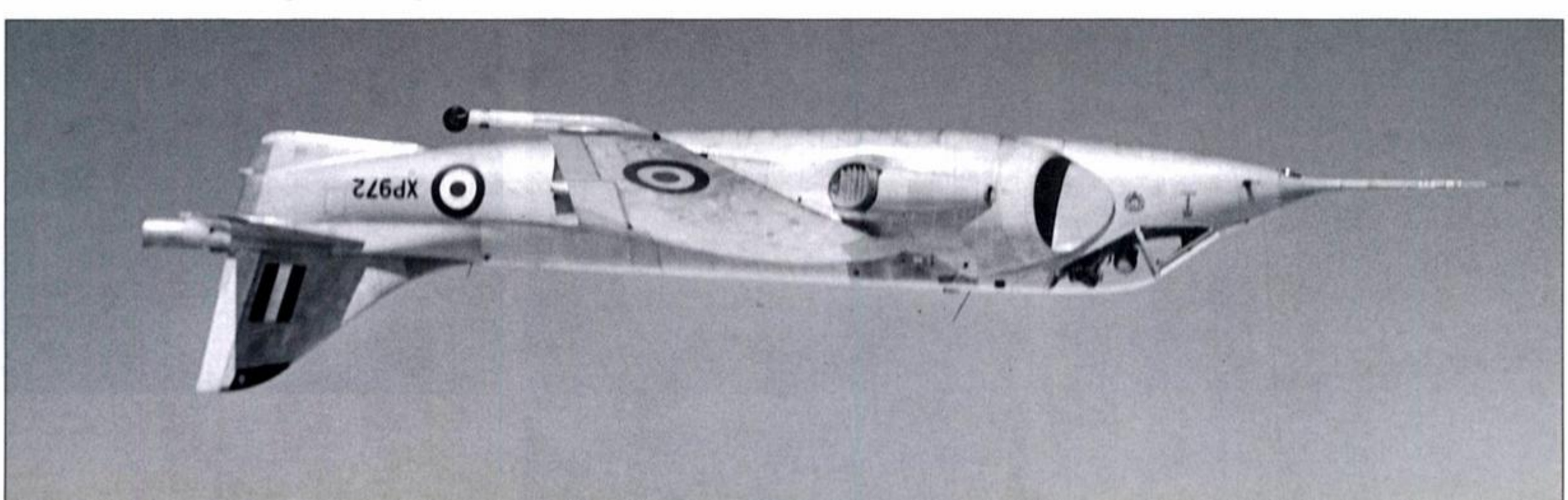
Never before had there been such integration of an engine and airframe, nor such prolonged research into the flow patterns around an aircraft hovering close to the ground, or moving slowly in different directions. British government wind tunnels were not allowed to be involved. Fortunately, the unique problems attracted the attention of the US National Aeronautics and Space Administration (NASA), whose head of tunnels, Dr John Stack, personally launched a programme which included a 1/7th-scale free-flight model with operative jets and a 1/8th-scale transonic tunnel model. Other models were tested by the British industry's own Aircraft Research Association (ARA) at Bedford, while a Pegasus engine was put through preliminary flight testing in the bomb bay of the first production Vickers Valiant bomber, WP199.

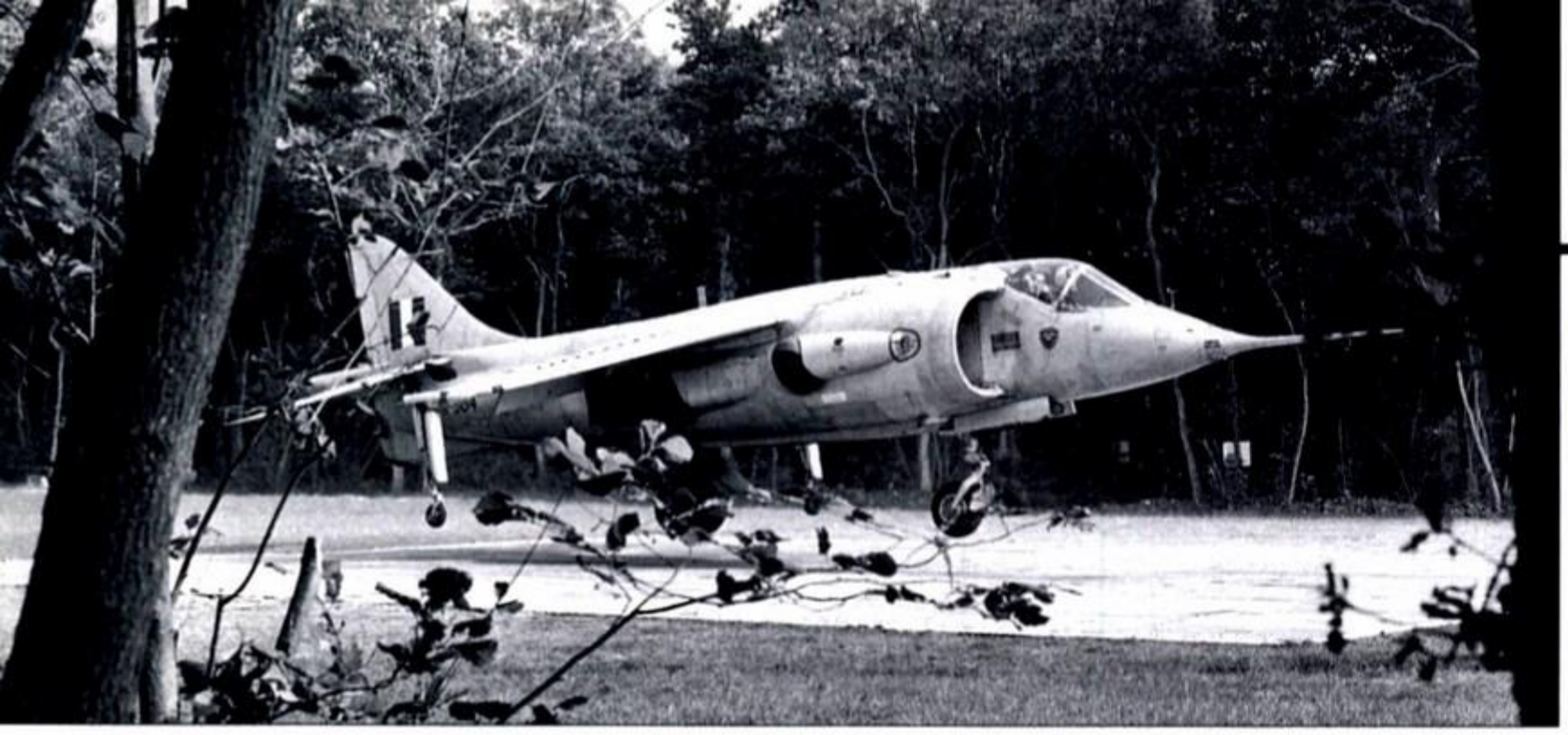
On 15 July 1960 the first P.1127 was taken by road from Kingston to Dunsfold for final assembly and system checks. On 31 August it began ground testing, stripped of almost everything that could be removed, such as the landing-gear fairings, nose boom and radio, and readied for flight. Hooker suggested to Camm that a thrust of 11,000 lb would be ample for initial flying from the runway, to prove handling in conventional flight. Camm retorted, "All Hawker aircraft handle perfectly, the first flight will be a VTO."

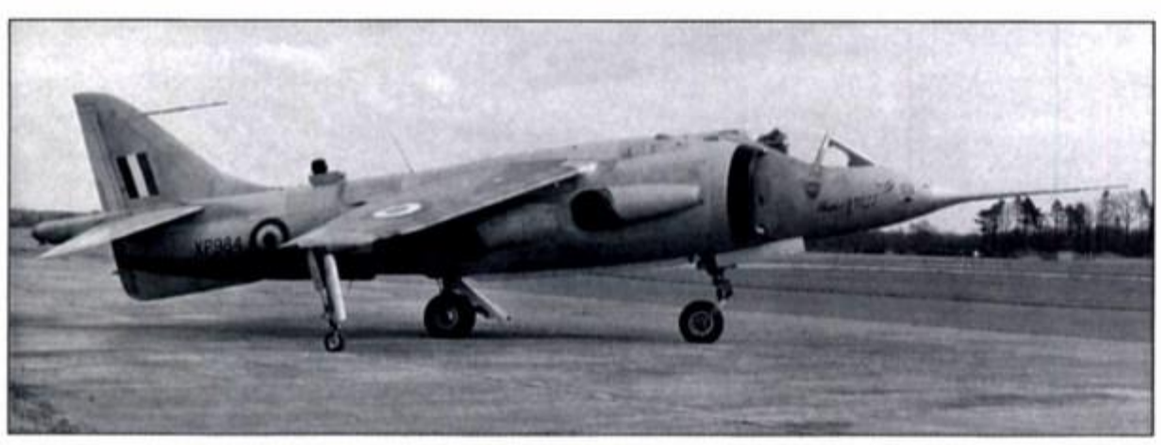
Hawker had installed a special gridded platform measuring 40 x 45 ft (12.2 x 13.7 m) so that in initial testing the engine jets could be ducted away to a distance, avoiding reingestion. XP831 was painted with black/white camera targets, restrained by loose tethers at the nose

Right: This view of the fourth P.1127 shows the kinked leading edge of the interim wing fitted to this aircraft, which also introduced the Pegasus 3 engine producing 13,500 lb (60.04 kN) and later 14,000 lb (62.26 kN) of thrust.

Below: Before its crash, XP972 was engaged in wing development trials.







Above and left: The last P.1127, XP984, was effectively a Kestrel prototype, minus the operational equipment intended for the latter's role. It had a longer fuselage (with a distinctive humped back), swept wing and a Pegasus 5 powerplant, rated at 15,000 lb (66.71 kN).

gear and outriggers, and then fitted with a light intercom served by a cable at the right wingtip. The only remaining problem was that Bill Bedford, in any case a big man, was made heavier by a plaster cast on a leg broken in a car accident while being chauffeur-driven in Germany. Hover testing began on 21 October 1960. As soon as the aircraft had lateral freedom it rolled slightly, and the horizontal component of jet thrust caused sideways movements and left/right yawing, often with various wheels scrubbing sideways on the platform, all of which was very difficult to counter. Bedford at first found it tricky, especially with limited control authority in order to conserve the bleed air. Hooker likened the aircraft to "a balloon on a string".

Gradually Bedford and deputy chief test pilot Hugh Merewether learned how to handle their strange charge, though in some situations control authority was poor. For example, in any crosswind the powerful momentum drag of the huge inlets overcame the pilot's pedals and swung the aircraft tail-on to the wind. On 19 November 1960 a cautious start was made to untethered testing, and it was at once found that in most respects this was easier. A start was also made to hovering over solid ground and taxiing, which uncovered many problems. As soon as taxi speed exceeded about 40 mph (64 km/h), control became marginal. As the main wheels hung down lower than the outriggers, the aircraft tended to roll to left or right. Nosewheel steering was inadequate, and the outrigger wheels oscillated violently. Soon Dunsfold's runway was crossed by wavy black lines of scrubbed rubber.

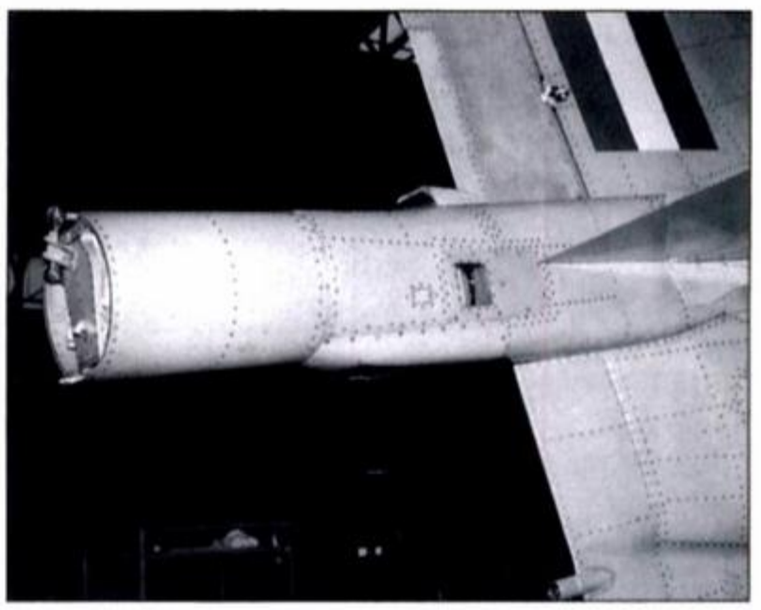
Earlier in November the Ministry had ordered four more P.1127s, XP972, '976, '980 and '984 (continuing the pointless policy of 'confusing the enemy' by not making numbers consecutive). Meanwhile, one of the most urgent modifications was to improve hovering yaw control. Eventually it was decided to change the puffer-jet system completely. Instead of continuous bleed, bleeding of compressed air was made entirely dependent upon pilot demand, varying according to stick and pedal position from zero up to the maximum. To increase yaw power, the swivelling nose and tail valves were replaced by separate fixed valves for pitch and yaw. To increase roll authority, the wingtip jets were made to blast upwards as well as downwards.

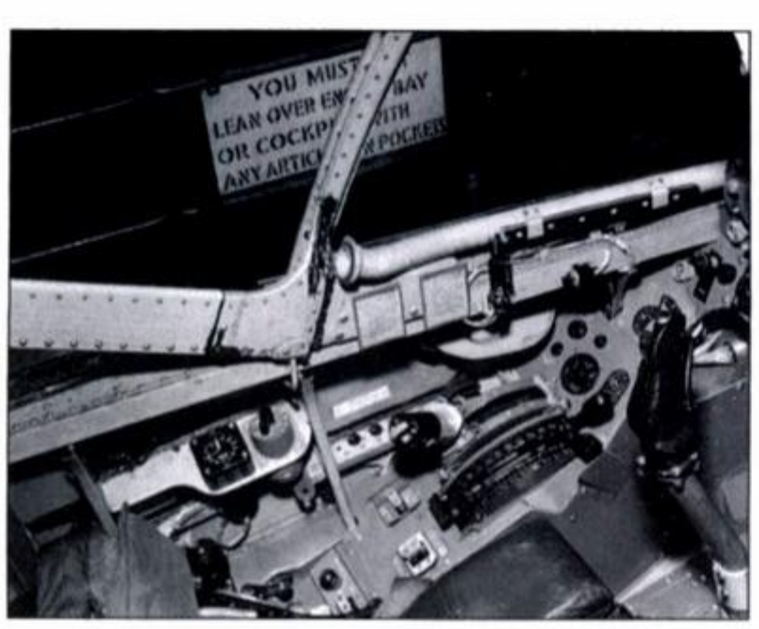
Engine/nozzle controls

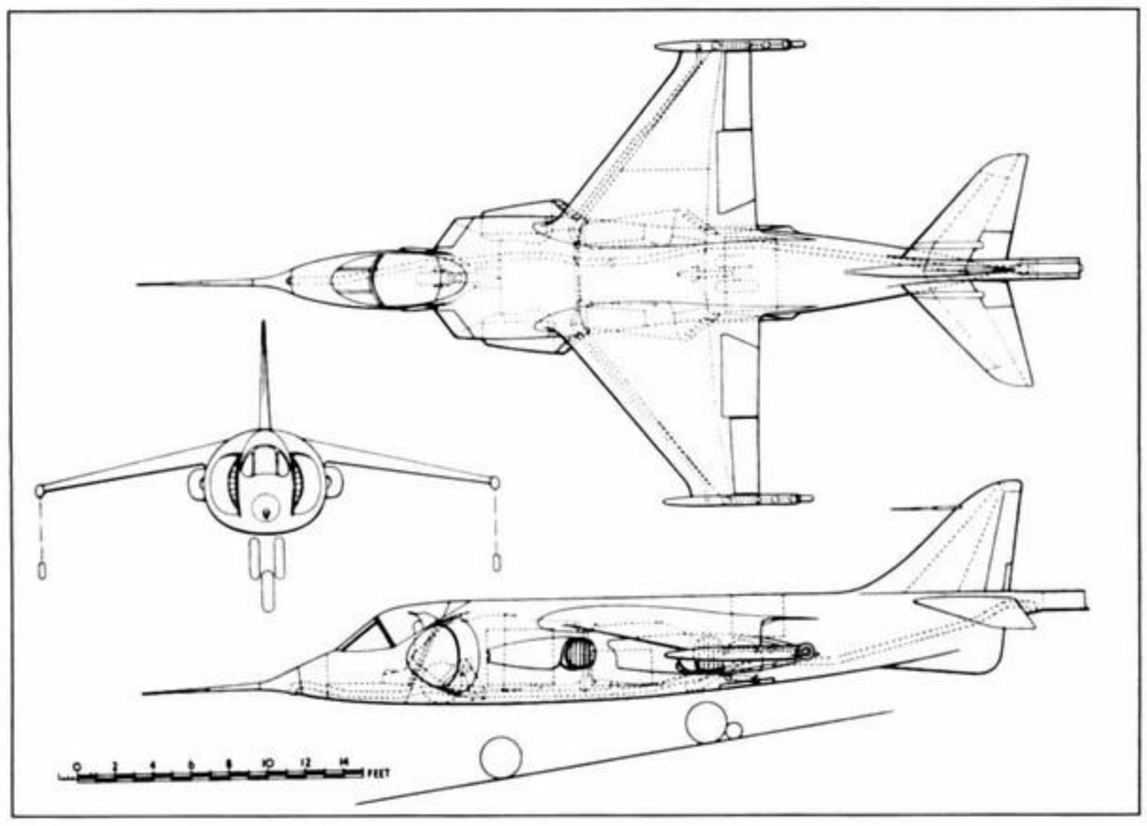
A further fundamental improvement was to rethink the engine/nozzle controls. First the hydraulic dashpot was eliminated, and then the ratchet and spring. Eventually, the pilot ended up with a much simpler and better box. It contained two levers, one a throttle giving direct control over power and the other a lever giving direct control over nozzle angle. These and other improvements were incorporated in XP831, and in XP836 which, with ordinary sharp-lipped engine inlets, had begun flying in July 1961. It was immediately obvious that control had been improved tremendously, and soon Bedford and Merewether set about the vital task of exploring the whole flight envelope and achieving accelerating and decelerating transitions. In March 1961 XP831, still with unsightly bellmouth inlets, had gone to the Royal Aircraft Establishment at Bedford. Here, on 13 March, Bill Bedford made the first conventional flight, storming ahead of the accompanying Hunter and lifting off without flap at about 150 kt (173 mph; 278 km/h).

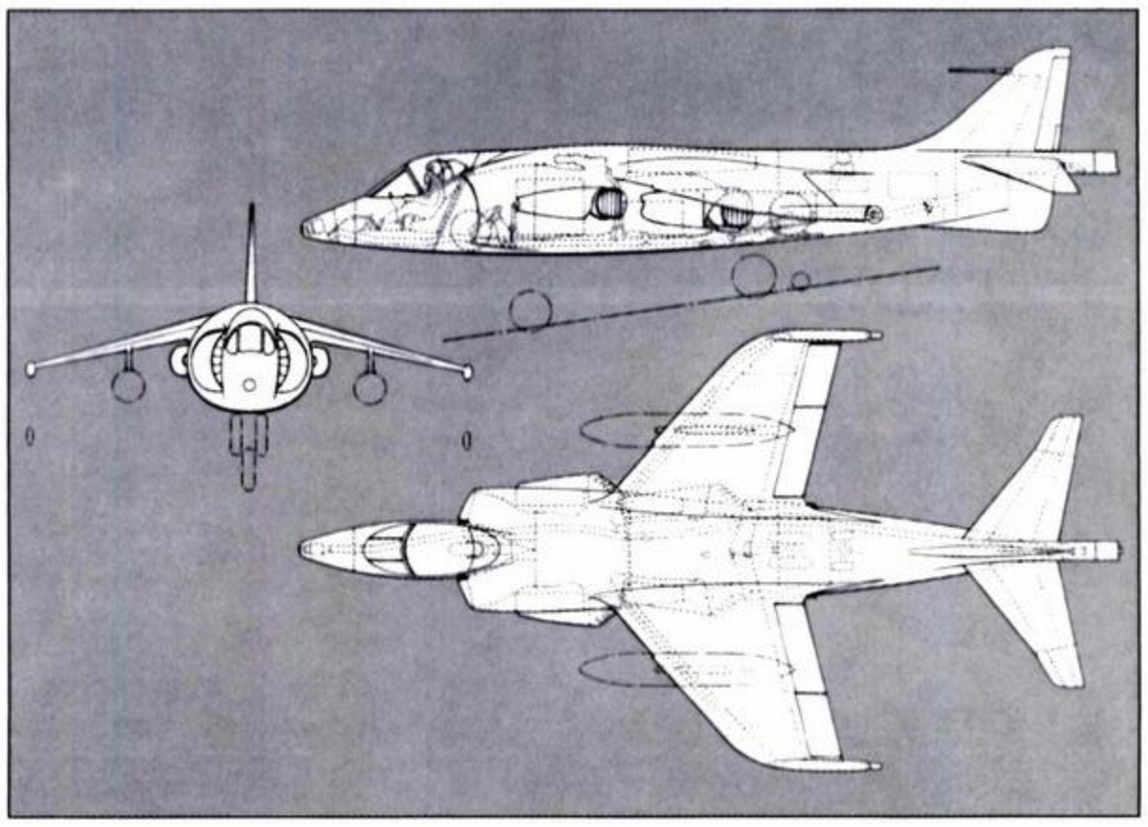
XP836 did all its first flights as a conventional

The layout of the P.1127's cockpit was comparatively conventional, with the exception of the nozzle rotation control to the right of the throttle on the left-hand side (bottom left). Considerable changes were made in cockpit layout before the Harrier entered production; the cockpits of today's second-generation AV-8B family are dominated by multi-function displays and barely recognisable. On the earliest P.1127s, 'pen-nib' fairings kept hot exhaust gases away from the rear fuselage. From the sixth aircraft, larger 'shovel' fairings were used (left). Pioneered on Rolls-Royce's Thrust Measuring Rig, reaction control (or 'puffer') jets (right), in the nose, tail and wingtips of the aircraft, used hot air bled from the aircraft's engine to keep the aircraft level in the hover. Also evident in this photograph is the stall/spin parachute fitted to the rear of XP984.









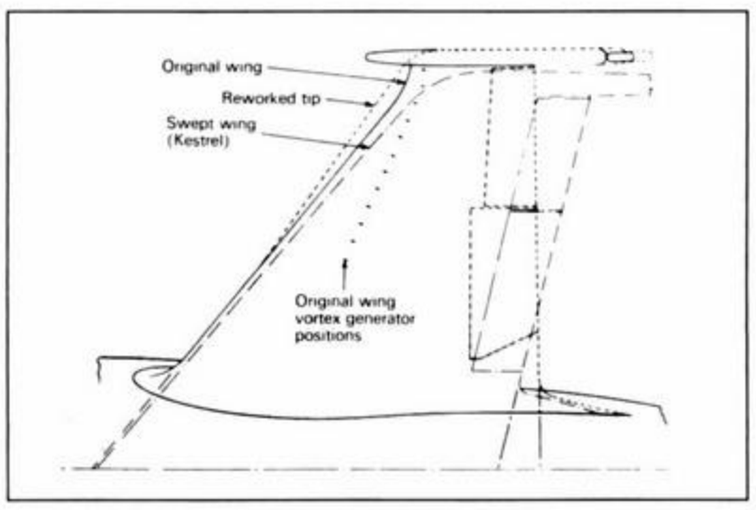
aircraft, and, as well as making the odd high-speed dash, also progressively brought down the speed close to the conventional stall at about 90 kt (104 mph; 167 km/h). XP831 kept making vertical take-offs followed by an acceleration forwards. Both pilots were now 'cracking' (vectoring) the nozzles with total confidence. At last, on 12 September 1961, the two sets of trials met, Bedford and Merewether both making complete accelerating and decelerating transitions. The Ministry sent an angry letter complaining that it had not given permission. Bedford apologised, and explained it was better to go ahead and fly than try to screech to a stop from over 100 kt (115 mph; 184 km/h) on the short Dunsfold runway.

A significant moment

This was hardly reported in the media, but it was one of the significant moments in aviation. Henceforth, an aircraft existed which could take-off vertically, hover, fly forward, backward or sideways, accelerate forward to the speed of sound, dogfight like a fighter, and come back to make a vertical landing. Although it was not a design objective, XP836 was dived to Mach 1 and then to Mach 1.2 in December 1961.

These high airspeeds were too much for the fibreglass front nozzles. On 14 December Bedford was flying 836 over Somerset when the left front nozzle broke off. Merewether, flying chase, did not see this, or he would have called out "No flaps!", because of the asymmetry. Bedford reduced speed and headed for RNAS Yeovilton, but as soon as he lowered the flaps the 1127 began a roll which could not be corrected. The only answer was immediate ejection, the aircraft by this time being at 200 ft (90 m) with its wings vertical. Later, a farmer appeared, bearing the nozzle. It was ascertained that the failure was due to a detail fault rather than choice of material, but to be doubly safe the front nozzles were changed to steel. Another modification was to change the pennib fairing behind the rear nozzles to a broad spade shape.

Back in 1959, Hawker and Bristol Aero-Engines (which in April of that year merged with Armstrong Siddeley Motors to create Bristol Siddeley Engines) had begun to study how the P.1127 formula might be extended to produce a supersonic tactical fighter-bomber. To do this required a much more powerful engine, with PCE (plenum-chamber burning) to give supersonic propulsive jets, and the result was the BS.100 engine rated at up to 35,800 lb (159.22 kN). Hawker schemed the P.1150, resembling a greatly stretched P.1127 with a thinner and more swept-back wing, a broader body with long sharp-lipped inlets and far greater fuel capacity. Over the years this eventually evolved into the P.1154RAF and into the P.1154RN, which the Fleet Air Arm made as different as possible. Utter failure of the two customers to agree anything like a common



The airframe differences between the later P.1127s (excluding XP984) and the Kestrel are clearly illustrated in these two company three-view drawings (top). The scrap view (above) details the changes made to the mainplane. The reworked tip and vortex generators were introduced on XP980.

Below: XS688, the first Kestrel, is seen during 1964 prior to its delivery to the Tripartite Evaluation Squadron, marked as a 'Hawker Siddeley P.1127' and fitted with rubber intake lips and a small tailplane. Note also that it lacks the wing dogtooth and wing vortex generators of later aircraft. '688 flew for the first time on 7 March 1964 from Dunsfold and was flown extensively until temporarily grounded in December. It flew again the following March and remained unique in the Kestrel fleet in having handed TES roundels on its wing upper surfaces. After its service with the TES it was shipped to the USA for further trials.

Below: At least three Kestrels (including XS688 and this aircraft, XS690) were built with instrumentation probes installed. The probes were later replaced with nose-mounted strike cameras. Note the camouflaged drop tanks (first flown on P.1127 XP980) on the underwing pylons.

Kestrel XS688 formates with a two-seat Hunter, an example of Hawker's last major production aircraft; the end of its production placed considerable urgency on a successful P.1127/Kestrel programme. XL564, at the time seconded to A&AEE for UHF radio trials, was the second production Hunter T.Mk 7 and remained in service until August 1998, with the Empire Test Pilots' School at DERA, Boscombe Down.

design contributed to the cancellation of the whole programme, including the BS.100 engine, in February 1965.

Thus, from 1959 the Kingston design office had two vectored-thrust projects in parallel. In terms of hardware the P.1127 was far ahead in timing of its supersonic successors. In 1962 the No. 1 aircraft was fitted with neat inflatable bags made of erosion-resistant rubber around the lips of the inlets. They could be inflated to offer a generous radius for hovering and then deflated to leave a sharp lip for transonic flight. Such inlets, immediately recognisable because they were black, were fitted on several later P.1127s. Unfortunately, when the stretched bag was deflated and flown at high indicated airspeeds it invariably ripped, and was frequently torn off, so the idea was eventually abandoned.

The final four aircraft quickly joined the programme. Unfortunately, equally quickly, only the final three were left. On 30 October 1962 Merewether was making tight turns in the third aircraft, XP972, when the compressor blades rubbed on the casing and started the first titanium fire (at least, the first in a British aircraft). A hasty landing was made at Tangmere but, as its landing gear failed to lock down, '972 crashed heavily and caught fire. Repair was deemed uneconomic.

More irritating was a failure of the first prototype in front of 110,000 spectators at the Paris air show on 16 June 1963. In February 1963 XP831 had carried out prolonged trials from HMS *Ark Royal*, with the ship both under way and at anchor. They were the first by a jet V/STOL from a ship at sea. Now, at Paris, Bedford was manoeuvring in the hover when a speck of grit got past the filters and jammed the servo to the nozzle drive motor. The nozzles all rotated to the rear just fast enough for Bedford to have no chance of building up forward speed to replace the lost lift, and '831 slumped heavily to the grass. In the worst possible place was a solid concrete obstacle. The pioneer VTOL – which had just been described to the crowd as "une développement d'une création française" – appeared to be destroyed, but it was eventually repaired for display in the Camm Memorial Hall of the RAF Museum. In 1992 it was loaned to the Science Museum, London.

Left and above left: The TES operated its Kestrels from all manner of surfaces, from grass to concrete, and in all conditions. The latter included night operations – the first by a jet V/STOL aircraft, namely XS693. A flare path provided the only illumination for the latter.

Pegasus 3

Despite priority on the BS.100, Bristol Siddeley's Chief Engineer (Pegasus), John Dale, never stopped wringing more thrust from the smaller engine. He obtained permission for a further upgrade, called the Pegasus 3. Thrust was increased to 13,500 lb (60.04 kN) by adding an eighth stage to the HP compressor and a second stage to the HP turbine. This ran in April 1961, and with a cleared life of 30 hours flew in the No. 4 aircraft, XP976, in April 1962. This aircraft had a wing with a kinked leading edge, with slightly reduced sweep outboard. With a rating increased to 14,000 lb (62.3 kN), the Pegasus 3 opened up the entire flight envelope, and was used for most of the P.1127 flying prior to 1965.

The fifth aircraft, XP980, introduced further improvements. The most obvious was that the wingtips were simplified, with no forward-projecting bullet fairing ahead of the outriggers. Other modifications were to fit a tailplane with 18° anhedral and area increased from 36.7 to 50.1 sq ft (3.4 to 4.65 m^2), a complete row of vortex generators over the outer two-thirds of each wing, and powered nosewheel steering.

The sixth and last P.1127, XP984, was the first to be fitted with the Pegasus 5, an even more important upgrade. This engine introduced a totally new three-stage fan (LP compressor) with an overhung first stage. As the outer parts of the Pegasus fan blades would be

XS689, '691, '694 and '695 keep tight formation over a solid cloud base on a sortie from West Raynham.

Kestrel F(GA).Mk 1

supersonic, reaching about Mach 1.5 at the tips, there would be no need for inlet guide vanes, as had been a feature of every previous axial jet engine. This in turn eliminated the need for protection against inlet guide vane icing, pioneering the way jet engines are designed today. Other new features included variable inlet guide vanes to the HP spool (which had all-titanium blading), a new fully annular combustion chamber with vapourising burners, and air-cooled blades in the HP turbine. The Pegasus 5 was designed for 18,000 lb, but initially was derated to 15,000 lb (66.7 kN) to get it into use quickly and with good reliability.

Swept wing

Apart from the new engine, which was heavier, the last P.1127 had a largely redesigned wing with pronounced sweepback. XP984 was also fitted with a tail parachute for stall/spin trials. It could have flown in October 1963, but problems with the new engine delayed the start of flight trials until 13 February 1964.

In 1959, the fact that the P.1127 was actually being built had jolted the Air Staff into thinking about whether it ought to learn about jet V/STOL aircraft, and perhaps even buy one or two. The first result was the issue in March 1960 of General Operational Requirement 345, which among other things suggested carriage of a 2,000-lb (907-kg) warload over a combat radius of 150 nm (173 miles; 278 km). Although the scene in the Air Ministry and Ministry of Aviation (previously of Supply) was one of utter confusion, combined with supposed horror at the estimated poor performance and high quoted price for the P.1127 (£560,000 each for a batch of 100), the belief very gradually dawned that it would be a good idea to learn a little about V/STOL aircraft, instead of rushing ahead with the Mach-2 NBMR-3. Unfortunately, most of the RAF's leaders scorned the P.1127, while others said it was too complicated and expensive.

A key factor was the long-established US involvement. The MWDP had never ceased to show interest in the P.1127, though once it had been shown to be a practical proposition it naturally began to taper off its financial support. On the other hand, emergence of the P.1127 as a simpler form of fast-jet V/STOL was of increasing interest to the US industry, which began to scent a faint whiff of competition. Thanks to the position of the RAF and UK Ministry of Aviation, which in essence said, "What a stupid little aircraft, and what a price!", the USAF felt it could ignore it. But Peter Thorneycroft, Minister of Aviation, went to Bonn to see if the Germans might be interested, and on 14 January 1961 the two governments announced "joint development of a lightweight strike fighter on the basis of the P.1127."

A week or two later a future USAF Chief of Staff, General John P. McConnell, told the author, "We reckoned an all-British P.1127 would just wither away, but with the Germans in the picture looked different." Perhaps if the funny British flat-riser was going to survive, the US ought to have a piece of the action. In mid-1961 the tentative decision was taken by the UK Air Staff to procure 'an evaluation squadron' for the RAF, but within weeks the plans shifted towards a TES (Tripartite Evaluation Squadron) of 18 aircraft. The idea was that the UK, USA and West Germany would each purchase six aircraft, and pay one-third of the development bill.

American backing

A big spur towards this decision was provided by an American millionaire, Larry Levy, a member of the MWDP staff. According to Sir Stanley Hooker, "He had the political clout and dollars to persuade the American, Federal German and British governments to purchase the aircraft and set up field trials." The first two were enthusiastic, but the British, who were still inclined to scorn any manned military aircraft and the P.1127 in particular, managed to get the plan for 18 aircraft to be cut back to nine (three for each country) and the planned autopilot/auto-stabilisation omitted, to save money.

Hawker received the Instruction to Proceed on 22 May 1962, but at this time the results of P.1127 testing were yielding important modifications. Agreement was reached to delay final design and manufacture to the last possible moment. The Tripartite Agreement was signed on 16 January 1963, and manufacture of the aircraft began six months later. At first called P.1127-Evaluation, they were from September

Kestrel Evaluation Squadron

Formed on 15 October 1964, the Kestrel (P.1127) Evaluation Squadron (more commonly known as the Tripartite Evaluation Squadron, or TES) was part of No. 38 Group, within the Central Fighter Establishment at RAF West Raynham (above). The nine Kestrels built for the unit carried tri-national roundels (left) and fin flashes and individual aircraft numbers.

The 10 officer pilots assigned to the TES, drawn from the USAF, US Army, US Navy, RAF and Luftwaffe, pose for the camera. From left to right, they are (rear): Sqn Ldr F. A. Trowern, RAF; Maj. Paul R. Curry, US Army; Wg Cdr D. McL. Scrimgeour, RAF (Commanding Officer); Oberst Gerhardt Barkhorn, Luftwaffe (Deputy Commanding Officer); and Flt Lt D. J. McL. Edmonston, RAF. (Front): Leutnant V. Suhr, Luftwaffe; Maj. John A. Johnston, US Army; Maj. J. K. Campbell, USAF; Cdr J. J. Tyson, US Navy (Deputy Commanding Officer); and Flt Lt R. J. A. Munro, AFC, RAF.

VZ-12 and XV-6A

The six US and German Kestrels were shipped across the Atlantic in 1966 and were initially designated VZ-12. (This designation was originally reserved for two P.1127s, to be serialled 62-4507/4508, never delivered.) Under the tri-service designation scheme, the aircraft became XV-6As and were given DoD serials (see table opposite). After ground-support testing at Fort Campbell, Kentucky, five aircraft were sent to the NATC at Patuxent River prior to the first of the Tri-Service Trials, aboard a number of ships, including the carrier USS Independence and the Marines' LPD USS Raleigh. After Navy trials the aircraft spent two weeks at the Army Proving Grounds at Eglin AFB, before four went to the USAF at Edwards AFB (64-18262/4/5/6) and two to NASA (64-18263/7). Of the latter pair, '263 became NASA 521 and was engaged in VIFF trials (top right). During the first of the Tri-Service Trials, the aircraft carried a suitable tail band (middle right). The aircraft that finished up at Edwards AFB carried 'U.S. AIR FORCE' titles, including 64-18262 (ex-XS688), seen here (bottom right) with individual code number '2', on 19 May 1968. Also at Edwards, 64-18264 was mounted on a rig for acoustic tests (below).

1964 designated Hawker Siddeley Kestrel F(GA).Mk 1 (fighter, ground attack), and were allotted serial numbers XS688-696.

Their manufacture overlapped that of the last P.1127, XP984. As already noted, this aircraft featured a swept wing, and formed the basis for the Kestrel. As originally built, the Kestrels were similarly powered by the Pegasus 5 with rating increased to 15,500 lb (68.93 kN), fed by inlets which at first had inflatable lips. Differences, compared with the final P.1127, included a thicker wingroot, which gave a humpbacked appearance, altering the 'sit' of the aircraft in flight. The fuselage was stretched by splicing in extra bays above the front nozzles and below the rear nozzles. In effect, this moved the wing to the rear, giving a better relationship between the centres of wing lift and gravity, and nozzle thrust in hovering flight. To improve airflow and increase pressure under the belly in low-altitude hovering flight, two axial strakes were added under the fuselage. The main landing gear was fitted with toe-operated brakes and with a new door stressed for use as an airbrake.

Among several other additions were an attachment under each wing for a pylon, plumbed for drop tanks, and a modified nose with the instrumentation probe replaced by a combat camera (XS688 started its test programme with the probe still fitted). Avionics were non-existent, apart from VHF radio, though provision was made for a Ferranti 'light fighter' sight and a Doppler and Bendix homing indicator to assist navigation.

The first Kestrel flew on 7 March 1964. In June it was fitted with a tailplane with extended tips that increased span from 12 to 14 ft (3.66 to 4.27 m), with a bob-weight in the drive circuit, and this became standard. Each aircraft was finished in silver, with its UK serial number but bearing specially contrived roundels and fin flashes incorporating the insignia of the three partner nations. The TES was formed at Dunsfold, location of the Hawker assembly plant, on 15 October 1964. Its strength was brought to 10 aircraft by adding the last P.1127, which was useful as a trainer. The commanding officer was Wing Commander D. McL. Scrimgeour, RAF. He had two deputies, Oberst Gerhardt Barkhorn of the Luftwaffe (301 victories in World War II) and Commander J. J. Tyson, Jr, US Navy. The US regarded the squadron's role as research and evaluation, and assigned test pilots. The RAF and Luftwaffe regarded the task as exploring operational use of a jet V/STOL, and assigned line pilots.

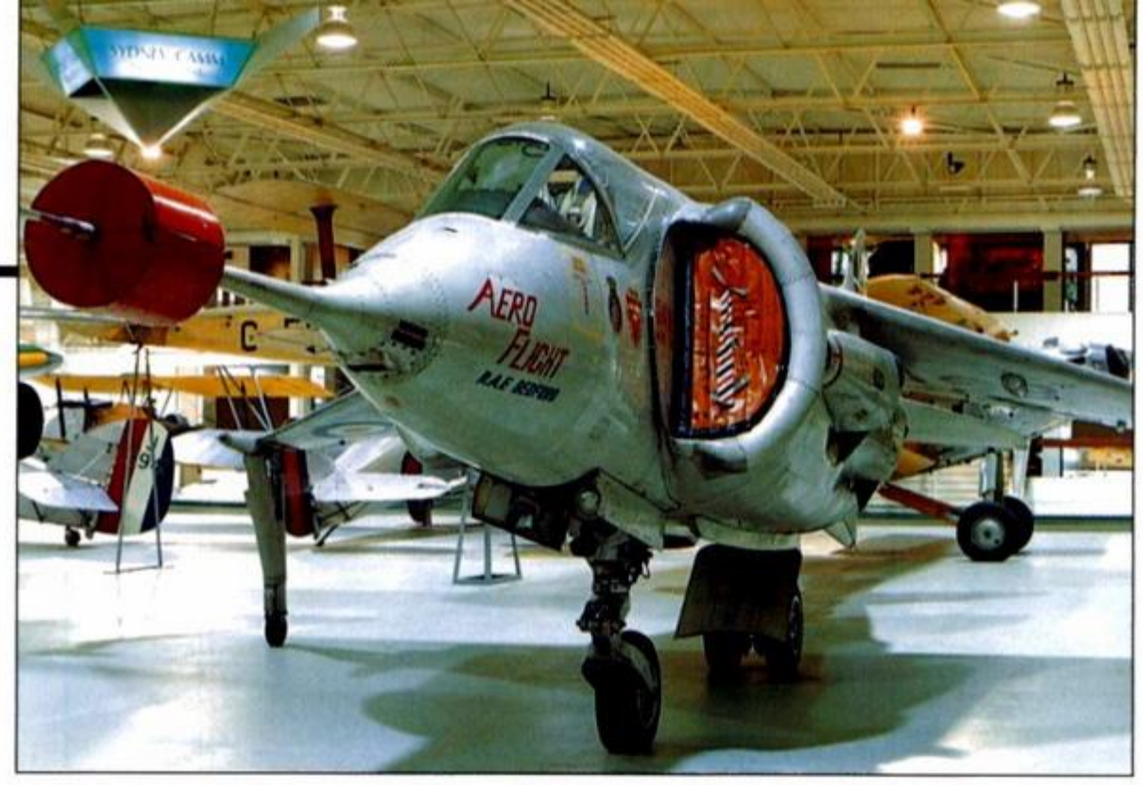
RAF West Raynham

After fairly trouble-free conversion, the TES moved to RAF West Raynham in April 1965 and got down to serious business. The aircraft were given a prominent nose number (in fact, the last digit of their serial number). About 600 hours were flown in 938 missions in the formal programme, completed in November 1965. Extensive operations were flown from tarmac, concrete, grass and a wide variety of special mats, pads and membranes. The nose camera was used for reconnaissance sorties, but strike missions had to be simulated. A significant proportion of the sorties were on instruments or at night. Wherever possible, dispersed operations were mounted away from established bases, living under canvas and using hastily prepared

Specifications

	P.1127 (late build)	*Kestrel F(GA).Mk 1*
Span	24 ft 4 in (7.42 m)*	22 ft 10 in (6.96 m)
Length (excluding probe)	41 ft 2 in (12.55 m)**	42 ft (12.80 m)
Height	10 ft 9 in (3.28 m)	10 ft 9 in (3.28 m)
Wing area	185 sq ft (17.19 m²)	186 sq ft (17.28 m²
Weight	(typical empty) 10,200 lb (4627 kg) (loaded empty) 15,500 lb (7031 kg)	(basic operating) 11,000 lb (4989 kg) (loaded VTO) 13,000 lb (5897 kg) (loaded STO) 17,000 lb (7711 kg) (maximum loaded) 19,000 lb (8618 kg)
Powerplant	11,000-lb (48.93-kN) Bristol Siddeley Pegasus 3 (BS.53/3)	15,500-lb (68.95-kN) Bristol Siddeley Pegasus 5
Cruising speed	?	524 mph (843 km/h)
Maximum speed	715 mph (1150 km/h)	750 mph (1207 km/h)
Service ceiling	49,800 ft (15179 m)	45,000 ft (13716 m)
Range	?	1245 miles (2004 km)

* XP984 22 ft 10 in (6.96 m)/** XP984 42 ft 0 in (12.80 m)



Right: Perhaps the product of a Friday afternoon spent in a local public house, this was one of Hawker Siddeley's more risqué advertising slogans during the 'swinging '60s'.

Far right: Thankfully, the first P.1127 has survived. One of the original exhibits in the Sir Sydney Camm Memorial Hall of the RAF Museum when it opened in 1972, XP831 has since been restored and later joined the Science Museum collection in London, on loan. It is finished in the markings of the Aerodynamics Flight, RAE Bedford, the aircraft's last operator, between 1965 and 1972.

'front-line' airfields, something which all three air forces had totally forgotten.

On 1 April 1965 the almost-new XS696 was damaged beyond repair in a violent ground loop. Apart from this there were no write-offs, and no pilot was killed. Altogether the TES was judged a great success, especially by the RAF. A little further flying was done up to April 1966, when six aircraft (those assigned to the US and Germany) were purchased by the USA at the 'used' price written into the agreement. The remaining two were reassigned to the Ministry of Aviation. XS693 played a major role in flight testing the much more powerful Pegasus 6 engine, developed for the P.1127RAF which became the Harrier. XS695 carried out trials at the Blind Landing Experimental Unit at RAE Bedford, crashed at Boscombe Down, but was repaired to serve at the RAE Farnborough.

XV-6A in America

The six American aircraft were redesignated as XV-6A VTOL research machines, with USAF tail numbers 64-18262/7. XS688 ended up at the USAF Museum, '689 was assigned to NASA at Edwards, and 690-692 and '694 were used for Tri-Service trials. The latter included important operations from USS *Guam*, *Raleigh* and the carrier *Independence*. As late as 1973 NASA Langley was exploring VIFF (vectoring in forward flight), today an integral part of the US Marine Corps Harrier combat repertoire.

Of course, the Kestrel was a stepping stone to the 95 per cent redesigned aircraft named the Harrier. Gradually, air forces and navies began to realise that aircraft which can operate from any small flat area can make the difference between victory and defeat. This was tellingly demonstrated in the South Atlantic in 1982 during the Falklands War. Thus, the Royal Navy, RAF and USMC have kept faith in V/STOL, developing the Harrier into an increasingly capable aircraft (the Harrier II) and staking billions of development dollars on its 21st century replacement – the Lockheed Martin/Northrop Grumman/BAe Joint Strike Fighter. **Bill Gunston**

XS695, the eighth Kestrel, was one of two that remained in the UK after the disbandment of the TES in February 1965. Here it is seen in about 1966, with RAF roundels applied and a dummy SNEB rocket pod under its wing. More recently, it has joined the RAF Museum's collection.

P.1127/Kestrel F(GA).Mk 1 airframes

serial	first flight date	fate (location of surviving aircraft in bold)
P.1127		
XP831	21 October 1960 (tethered) 19 November 1960 (free)	last flight October 1972; **RAF Museum (on loan to Science Museum, London for display)**
XP836	7 July 1961	crashed Yeovilton after cold nozzle detached in flight, 14 December 1961; scrapped
P.1127 development batch		
XP972	5 April 1962	(first aircraft sponsored by MoS/MoA). Crash-landed Tangmere, 30 October 1962; scrapped
XP976	12 July 1962	(Pegasus development aircraft) last flight 1965; fuselage to Wittering for BDR training, later scrapped
XP980	24 February 1963	damaged in practice forced landing, Boscombe Down (date?); **displayed FAA Museum, RNAS Yeovilton**
XP984	13 February 1964	(Kestrel prototype) crashed 31 October 1975; **displayed at BAe Dunsfold (gate guard)**
Kestrel F(GA).Mk 1/XV-6A		
XS688/64-18262	7 March 1964	TES aircraft '8'; to USA 1966 for Tri-Service Team at NAS Patuxent River (coded '2') and USAF trials; withdrawn January 1970; **USAFM Annex, Wright-Patterson AFB, Ohio**
XS689/64-18263/NASA 521	28 May 1964	TES aircraft '9'; to USA 1966 for Tri-Service Team at NAS Patuxent River (coded '3'); to USAF, then NASA 1967 for VIFF trials; withdrawn January 1970; (wings to XS688 restoration), **displayed NASM, Washington, DC**
XS690/64-18264	5 August 1964	TES aircraft '0'; to USA 1966 for Tri-Service Team at NAS Patuxent River (coded '4'); to USAF; withdrawn January 1970; **stored at Cairns AAF, Fort Rucker, Alabama**
XS691/64-18265	5 September 1964	TES aircraft '1'; (allocated to Luftwaffe; marks not taken up); to USA 1966 for Tri-Service Team at NAS Patuxent River (coded '5'); to USAF; withdrawn January 1970; to NASA for spares recovery; remains accidentally dropped into James River from helicopter, en route to Virginia Air Power Park, Hampton (date?)
XS692/64-18266	7 November 1964	TES aircraft '2'; to USA 1966 for Tri-Service Team at NAS Patuxent River (coded '6'); withdrawn January 1970; to NASA for spares recovery, **displayed as 'NASA520', Virginia Air Power Park, Hampton**
XS693*	15 November 1964	TES aircraft '3'; fitted with Pegasus 6 1966/67 ('Harrier prototype'); crashed en route to Boscombe Down, 21 September 1967; scrapped
XS694/64-18267/NASA520	10 December 1964	TES aircraft '4'; to USA 1966 for Tri-Service Team at NAS Patuxent River (coded '8'); to USAF, then NASA 1967; ground looped, Wallops Island, Virginia, 1967; (wings to XS689 restoration)
XS695*	17 February 1965	TES aircraft '5'; to RAE 1966; crash-landed Boscombe Down, 15 March 1967; to Royal Navy as ground trainer; **stored at RAF Museum Storage and Restoration Centre, RAF Cardington**
XS696*	5 March 1965	TES aircraft '6'; ground-looped on take-off, West Raynham, 1 April 1965; reduced to spares and scrapped

* Some confusion has existed regarding the US DoD serials allotted to Kestrels XS693, '695 and '696. Though the serials 64-18262 to -18270 were presumed to have been allotted to the nine aircraft, there is no documentary evidence confirming that these three machines would have become 64-18267, -18269 and -18270, respectively, had they been shipped to the US. Photographs of an aircraft bearing 64-18267 and references to an aircraft with this serial number suffering landing gear damage in a landing accident in 1966 suggest that this serial number was not in fact allotted to XS693, but to XS694 instead.

No. 105 Squadron, IDF/AF

Never equipped with the top aircraft in service, Israel's second fighter unit, No. 105 Squadron, cannot claim the hundreds of kills of which other Israeli fighter squadrons proudly boast. However, it enjoyed a brief period as the IDF/AF's top fighter squadron between 1959 and 1962, and the contribution made by its second-line fighters in four wars cannot be underestimated.

Among No. 105 Sqn's types has been the Sa'ar, an early example of local aviation expertise. The type was an upgrade of the Dassault Super Mystère, fitted with a lighter, more powerful and more economical Pratt & Whitney J52 turbojet of the type found in the A-4 Skyhawk. This threesome from No. 105 Sqn flies against a backdrop of the historic Jewish fortification at Masada, prior to the Yom Kippur War.

A lack of fighters precluded the establishment of No. 105 Squadron in the Israeli Defence Force/Air Force (IDF/AF) in 1948, while a lack of fighter pilots delayed the establishment of the squadron until 1950. This situation can be directly attributed to the early days of the IDF/AF: in the summer of 1948 the IDF/AF had a single squadron of Avia S 199 fighters – No. 101 Squadron – which was hard-pressed during the Israeli Independence War. The low serviceability of the S 199, coupled with many losses, resulted in an uneasy situation in which there were too many fighter pilots and too few available fighters. As a result, the IDF/AF needed a more reliable fighter, and 50 Supermarine Spitfires were purchased from Czechoslovakia that summer.

The initial plan, based on the expectation that the Czech Spitfires would arrive quickly, was to form a second fighter squadron under the command of Boris Senior. He was sent to Czechoslovakia to lead the delivery of the Spitfires to Israel while his intended deputy, Leslie Shagam, was left behind in Israel to plan the formation of the new squadron at Kfar Sirkin, the former RAF Petah Tikva. In the event, the Spitfires did not reach Israel when expected. Fewer than 20 Spitfires reached Israel from Czechoslovakia before the end of the Israeli Independence War, and all were operated by No. 101 Squadron.

More fighters arrive

Following the end of the Israeli Independence War in 1949, the IDF/AF's difficulties regarding its fighter force changed almost overnight. The experienced foreign volunteers left Israel and the remaining Spitfires arrived from Czechoslovakia. By the end of 1949, the IDF/AF had many fighters, though most were still in crates, but not enough pilots to fly them. The problem was exacerbated by the delivery of North American P-51 Mustangs from the US. To solve the problem, the IDF/AF decided to train its own fighter pilots and in mid-1949 an Operational Training Unit (OTU) course was introduced within No. 101 Squadron. In August 1950 the OTU activity of No. 101 Squadron was reorganised as 755 Flight under the command of Captain Menachem Bar, a pilot who had graduated from his own Spitfire OTU in the summer of 1949.

It was decided to separate the OTU activity from the operational activity of No. 101 Squadron while at the same time standardising each unit with homogeneous equipment. On 20 November 1950 an order was issued regarding the formation of a new fighter unit, No. 105 Squadron, which was to form at Ramat-David air base as an OTU equipped with Spitfires. The IDF/AF first fighter squadron, No. 101 Squadron, was standardised on the Mustang, although it retained its two reconnaissance Spitfires until No. 105 Squadron reached operational status.

In December 1950 the second IDF/AF fighter squadron came into being under the command of Captain Bar. The new unit immediately began OTU for the graduates of the IDF/AF 2nd Flying Course (FC) which graduated the IDF/AF Flying School (FS) on 14 December 1950. Up to the end of 1952, the squadron conducted five OTU courses and produced 42 fighter pilots. Another three pilots failed to graduate, and one more was killed in

Spitfires equipped No. 105 Sqn upon its formation as an OTU. Ground attack skills were taught, using both rockets and bombs. This clipped-wing Mk IXE has a bomb rack and a set of four rocket rails under each wing.

Above: Lt Omri Ariav walks past a No. 105 Sqn line-up at Ramat-David. Ariav, a reservist, was killed when two No. 101 Sqn P-51s collided over Ramat-David on 18 August 1954 during an aerobatic display.

Left: The unit badge, a scorpion over a winged crest, is seen here in close-up, applied to the port engine cowling of one of the unit's bare metal Spitfire Mk IXs.

an accident. Significant though short-lived changes were introduced in 1953. In addition to the OTU course, No. 105 Squadron introduced a PAI course in January 1953, a lesson from the RAF PAI course which Captain Bar had attended in 1952. While Captain Bar was away on the course the squadron was commanded by Major Yeshayahu 'Shaya' Gazit. After the PAI course ended Captain Bar was succeeded by Major Israel 'Tibby' Ben-Shachar, in April.

By mid-1953 the IDF/AF was in need of still more fighter pilots. In addition to No. 101 Squadron with Mustangs and No. 105 Squadron with Spitfires, the IDF/AF formed No. 117 Squadron with Gloster Meteors, plus two fighter-bomber squadrons, No. *** Squadron and No. 110 Squadron, with de Havilland Mosquitos. The increased demand for fighter pilots resulted in the formation of No. *** Squadron as a second Spitfire OTU source. During 1953, No. 105 Squadron produced 19 new fighter pilots who graduated from two OTU courses, while No. *** Squadron produced 13 new fighter pilots, also in two OTU courses. Of those 32 new pilots, 10 were destined for the Mosquito fighter-bomber wing. It was decided that no further future Mosquito pilots would attend the Spitfire OTU; this, coupled with a contract to sell 30 Spitfires to Burma and the fact that no more PAI courses were conducted, made it clear that there was no room for two Spitfire squadrons. No. *** Squadron was amalgamated with No. 105 Squadron and on 21 March 1954 Captain Itshak 'Tsahik' Yavneh, the former commander of No. *** Squadron, succeeded Major Ben-Shachar as the commander of No. 105.

Training Burmese pilots

Completing his tour of duty as a fighter squadron commander, Captain Yavneh was succeeded on 30 July 1954 by Captain Moshe 'Monik' Tadmor who was to command the unit for over two years. The previously-mentioned Burmese contract included the training of Union of Burma Air Force (UBAF) pilots in Israel, and No. 105 Squadron organised a special OTU course for five UBAF pilots, beginning in November 1954. Only four UBAF pilots graduated from the OTU, the fifth being killed in an accident in January 1955. They were the only foreign pilots to be trained by No. 105 Squadron.

The influx of jet fighters rendered the Spitfire obsolete and by 1955 it was decided to convert the OTU to the Mustang, but this decision was soon superseded by another to cease OTU courses for piston-engined fighters, as the future clearly belonged to jets. This idea was particularly promoted by Major Yavneh, who became the IDF/AF FS CO in February 1956. However, implementation was slow and the Spitfires were not withdrawn from use until May 1956, No. 105 Squadron re-equipping with the Mustang. Only a single OTU course was conducted on Mustangs, beginning in July 1956. The trainees were fresh pilots who had graduated from the 20th FC the previous month. Following the graduation of the OTU in September 1956 the squadron also organised a Mustang conversion for Mosquito reserve pilots. No. 105 Squadron was then scheduled for disbandment but events delayed it: No. 105 Squadron went off to its first war flying a second-line fighter with a few OTU instructors, a few reserve Mustang pilots, a few reserve Mosquito pilots who had just been converted to the Mustang, and a number of new pilots who had graduated from the Mustang OTU in September 1956. It was a pattern which No. 105 Squadron was to follow in three subsequent wars.

The Sinai Campaign

The FS instructors staffed No. 116 Squadron, which performed the 'cable cutter' missions, and No. 105 Squadron had every reason to be proud of its Sinai Campaign operations. Although hostilities began on 29 October 1956, No. 105 Squadron's Mustangs were kept on the ground at Ramat-David until the morning of 31 October; the IDF/AF was reluctant to send its piston-engined fighters to a warzone dominated by jet fighters, prior to the attack on Egyptian Air Force (EAF) air bases.

Two No. 105 Squadron formations were dispatched on the morning of 31 October on a close air support (CAS) mission at Abu Ageila but both formations diverted to battlefield air interdiction (BAI) missions after failing to decide who was friend and who was foe at Abu Ageila. The first formation took off from Ramat-David at 07.45 local time and was led by Major Tadmor, with Sub-Lieutenant Gideon Magen (graduated from the OTU the previous month), Lieutenant Yoseph Kopel (an OTU instructor) and Sub-Lieutenant Levy Zur (a graduate from the OTU the previous month). The second formation took off at 08.00 and was led by Captain Eldad Paz (an OTU instructor), with Sub-Lieutenant Asaf Ben-Nun (another graduate from the OTU the previous month), Sub-Lieutenant Chaim Niv (graduated from the OTU the previous month) and Captain Yeshayahu Bodilewski (a reservist). The first formation diverted for a BAI mission in the area of Jabel Libni and returned safely to

Below: Eighteen Spitfires, led by Major Yeshayahu Shaya Gazit in 2058, participated in a flypast on 20 March 1952 to mark the graduation of another group of OTU trainees. Six of the Mk IXs were flown by the fresh OTU graduates. Prior to the take-off, the 18 aircraft were lined up on the runway. Spitfires 2052, 2054 and 2055 were three of the aircraft, seen here lined up on the tarmac prior to the event.

Below: A line-up of No. 105 Sqn Spitfires is seen at Ramat-David. Black and yellow stripes adorn their rudders; propeller spinners were yellow.

Above: Given the nature of its role, minor accidents were commonplace during No. 105's period as an OTU between 1950 and 1956. This aircraft, Spitfire 2089, suffered 'Cat. 3' damage in a landing accident on 3 September 1955.

Left: No. 105 Sqn instructors and their OTU trainees pose for the camera in December 1953. On the wing (left to right) are: Sub-Lt Rafael Rot, Sub-Lt Mordechai Ohad and Sub-Lt David Helman. Standing: Lt Akiva Presman (instructor), Capt. Azriel Ronen, Sub-Lt Aryeh Fredlis, Maj. Israel Ben-Shachar (CO), Lt Gad Gotman, Lt Naftali Altman and Lt Yeshayahu Baraket.

Ramat-David; the second diverted for BAI work on the Abu Ageila-El-Arish road and lost Sub-Lieutenant Ben-Nun to AA fire, although he made a belly landing in Israeli territory and returned safely.

Another two No. 105 Squadron Mustangs were lost on 31 October 1956. At 13.00 a three-ship led by Captain Paz, with Sub-Lieutenant Aryeh Dagan (graduated from the OTU the previous month) and Lieutenant Amos Melamed (a reservist), took off for a BAI mission on the Jabel Libni-Bir Gafgafa road. The leader was shot down by AA fire, made a successful belly landing in the desert and walked west some 60 km (37 miles) in 37 hours to return to the Israeli lines. Less successful was the leader of the formation which took off from Ramat-David at 15.25 to attack Egyptian strongpoints at Abu Ageila – as his wingman, Sub-Lieutenant Niv, recalls:

"That's the flight when 'Monik' was killed: 'Operational Order attack armour Bir Gafgafa'. It was in the afternoon, 'Monik' was the leader, I was No. 2, Shlomo Hagani was No. 3 and I cannot recall who was No. 4. We flew with internal ammunition, 5-in rockets and bombs, and we passed over Egyptian forces. I think that we flew too high, maybe even too slow. When you flew low you gave less warning to the AA gunners. There were no radars, it was all manual: the gunner suddenly spotted an aircraft, so if the aircraft flew at 30 ft the AA might not have time to react, but if the aircraft flew at 200-300 ft then the gunner saw it at 3-4 km range and he had the time to do whatever he had to do. There was AA fire and I did not see 'Monik' get hit, though I certainly felt and knew that I was hit, when suddenly Hagani screamed, 'No. 1, you are pouring black smoke!' I looked and I saw a little bit of black smoke and I wondered why he had screamed, but 'Monik' started to turn to the right. Hagani said, 'I am pressing on with No. 4' and I think that he also told me to follow No. 1. 'Monik' did not answer [Hagani's call], from that moment on I did not hear him and I did not try to call him. I thought that if he had not answered Hagani he would not answer me. 'Monik' turned and flew home with full power, and I followed him. At a certain moment, it is difficult to synchronise the events, he launched the rockets, which is a safety precaution before a possible emergency landing. He also jettisoned the canopy, but his windshield was black, I am almost certain that it was covered with oil because the glycol was not black. Then his engine stopped and I started to pass him, so I turned to the left and then reversed to the right but by the time I finished this very simple manoeuvre, maybe 10-15 seconds, he was already burning on the ground. The central part of the fuselage, with the cockpit and the fuel tanks, was burning in a big fire. I made several passes and turned for home. I returned alone at low altitude, it was already dusk, and when I landed I had a flat tyre (due to AA fire hits). The aircraft developed a swing to the right but I managed to brake quickly and stopped on the runway. Technical Officer 'Norik' (Har'el) came to me and I said, 'I think that 'Monik' was killed.' Why did not I say, 'Monik' was killed? I had two reasons. First, I did have the slightest hope that during the 10-15 seconds in which I did not see him he had flown away and another aircraft had crashed and, second, I was afraid of this terrible statement."

New commanding officer

Following the death of Major Tadmor the command of the squadron passed to Lieutenant Avraham Hacohen, a reservist, but Lieutenant Shlomo Hagani, also a reservist and No. 3 on Tadmor's last flight, actually commanded the squadron until the end of the war. During the Sinai Campaign, No. 105 Squadron flew a total of 50 sorties and claimed the destruction of 20 vehicles, 12 tanks, six half-tracks, two tankers and two artillery pieces. The squadron flew only BAI and CAS missions and lost three Mustangs to AA fire; the Mustang's cooling system was found to be particularly vulnerable. One pilot was killed, one landed behind enemy lines and returned by foot, and a third pilot landed on Israeli soil. It was a fair achievement for a squadron which was originally to be disbanded but was hurriedly prepared for war in a matter of days.

Disbandment was only postponed by the Sinai Campaign and on 20 January 1957 No. 105 Squadron ceased to exist, though only for a year. Reformed as a result of an order issued on 20 August 1958, No. 105 was transformed from second-line fighter squadron to top IDF/AF fighter unit. As a logical outcome to the purchase of the Dassault

Above: Sub-Lt Shamuel Bavli landed damaged Spitfire 2023 after a mid-air collision with Sub-Lt Ya'acov Agassi on 27 November 1951, during an OTU training sortie. The damage to the tail section was caused by the propeller of Sub-Lt Agassi's Spitfire, while the damage to the propeller of Spitfire 2023 was caused during the landing at Ramat-David.

Below: While Sub-Lt Shamuel Bavli managed to return to Ramat-David following the aerial collision on 27 November 1951, Sub-Lt Ya'acov Agassi was forced to make an emergency landing near Yavniel.

Mustang 2342 served with No. 105 Sqn in the summer of 1956. This aircraft was purchased in the US and arrived in Israel, by ship, on 28 June 1954. Remnants of this aircraft were used by an IDF/AF reserve pilot, Maj. Israel Itshaki, to rebuild Mustang 4X-AIM during the late 1970s/early 1980s.

Ouragan and Dassault Mystère IVA, Israel ordered 18 Dassault Super Mystère B.2s and took an option on a further six. In fact, the latter was merely a stop-gap until the Dassault Mirage IIIC became available. IDF/AF test pilot Major Daniel 'Danny' Shapira was the first Israeli pilot to fly the Super Mystère when he commenced an evaluation of the type on 26 February 1957. The small quantity involved in this purchase meant that two approaches were evaluated. The first was to split the Super Mystères between the current two Mystère squadrons – No. 101 Squadron at Hatzor air base in the south and No. *** Squadron at Ramat-David in the north. Such a proposition offered operational advantages but complicated maintenance and logistic problems, prompting a new approach, concentrating all the Super Mystères in a single unit. This was the preferred option and No. 105 Squadron was selected to operate the new interceptor. Its new base was Hatzor, alongside the Mystères of No. 101 Squadron and the Ouragans of No. 113 Squadron.

The squadron reforms

No. 105 Squadron was reformed in August 1958 with Major Ya'acov 'Yak' Nevo as the CO and Captains Arlozor 'Zorik' Lev and David Ivry as his deputies. The following month, Major Nevo, Captain Lev, Lieutenant Ohad Shadmi and Sub-Lieutenant Ilan Ron began a conversion course with EC 1/10, Armée de l'Air at Creil; Captain Ivry remained in Israel to organise the unit's formation.

The conversion was also attended by Major Daniel Shapira, who first flew the Super Mystère at Creil on 4 September. Later that month he was joined at Creil by the four No. 105 Squadron pilots. Sub-Lieutenant Ron first flew there, an orientation flight in a Mystère II, on 20 September and made his first Super Mystère flight three days later. The conversion flights at Creil continued until 12 October, the date of Sub-Lieutenant Ron's last Super Mystère flight. Daniel Shapira's logbook reveals that the conversion included a RAF Valiant interception sortie, and even a unique flight by an Israeli pilot over London in a French fighter!

The IDF/AF pilots were not accustomed to bad weather, so prior to the conversion at France the would-be Super Mystère pilots were trained in instrument flying on Gloster Meteors, together with two French-speaking controllers who would accompany them to France. Ilan Ron – now an EL-AL captain – explains:

"The preparations in Israel were to fly Meteors and practise ground control approach (GCA), because in France the weather is not like in Israel. It was all done in French, so we learned French and while we flew, we talked French.

"We travelled to Creil with a group of ground crews and two French-speaking controllers who were to be in the control tower; in case we could not understand, they would translate. Initially we did two orientation flights in Mystère IIs. The most interesting and unusual thing that no one seems to grasp today is that in the morning we learned the Super Mystère and in the afternoon we flew it! Hence, many strange incidents occurred. For example, once when I came in to land and the undercarriage did not extend, I had to use emergency extension but I did not know where the handle was, so a pilot was brought to the control tower to tell me!

"In the weather in which we flew we would have never taken off in Israel. Eight oktas of clouds [i.e., full cloud cover] at low altitude. You took off, climbed through the clouds, did your exercise (at high altitude) and requested GCA back to base. We participated in NATO exercises, so that when you wanted an air combat (training) you contacted the sector controller and he would do an interception on whichever aircraft was available in the area. I remember an air combat with 'Yak' versus [Hawker] Hunters which nailed us at first, but then we managed to nail them, only to land almost starved of fuel."

In mid-October Lieutenant Shadmi and Sub-Lieutenant Ron joined the ground crews at Cambrai while Major Nevo and Captain Lev crossed the Mediterranean to Algeria to practise the weapons of the Super Mystère. The first six IDF/AF Super Mystères were flown to Istres where their engines were exchanged and 1300-litre (286-Imp gal) external fuel tanks were fitted prior to the ferry flight to Israel. Ilan Ron was then a young sub-lieutenant who had gained his wings just a year previously. He recalls:

"(Lieutenant) Shadmi was in his room, reading, learning. I went to the mechanics and asked them for work. They told the French that I was a pilot and they replied, 'Don't kid us, this is a boy, not a pilot.'

"The greatest joke was when the day of the test flight arrived. The pilot climbs into the plane and seats himself, and then the mechanic climbs up the ladder and helps him with his helmet and oxygen, etc. None of the French mechanics was willing to help me; they said, 'you're making fun', so an Israeli mechanic helped me. When I started the engine they fainted; when I taxied away they were no longer alive; and when I took off they closed their eyes and said, 'He's not coming back alive!'"

In the autumn of 1956 the IDF/AF decided to convert Mosquito reserve pilots to the Mustang in anticipation of the Mosquito's withdrawal from use. No. 105 Sqn organised a conversion course but as it ended the Sinai Campaign broke out, and most of those pilots attending returned to flying the Mosquito. In this photo the Mosquito pilots on Mustang conversion are seen in front of No. 105 Sqn's building at Ramat-David.

Sub-Lieutenant Ron flew that first test flight on 25 November, and three days later he flew a fuel transfer test flight. The plan for the ferry flight was to fly in three pairs at five-minute intervals. The leader was a French pilot and his wingman was Sub-Lieutenant Ron. The first six IDF/AF Super Mystères left Istres on 3 December 1958 and arrived at Hatzor the next day after a three-hour 55-minute flight and a night stop at Brindisi, Italy. For Ron, the ferry flight to Israel was an absorbing experience:

Training in secrecy

"We carried the identity cards of French test pilots because the flight was a secret. The Italians were told that we were French test pilots on a range test and that we were flying to Algeria. My name was 'Pierre Ron'. I had two

No. 105 Sqn service Mustang 2319 had a landing accident on 30 July 1956 while flown by an OTU instructor, Lt Yoseph Kopel, but it met its fate on 31 October 1956 – shot down by Egyptian AA fire.

Super Mystère 17 was lost on 29 June 1960 when Sub-Lt Shamuel Hetz ejected after an aerial collision with Capt. Rafael Rafi Har-Lev in Super Mystère 16, who landed successfully. This natural metal scheme was the symbol of the IDF/AF's front-line interceptors for almost two decades. As the first Super Mystères arrived, earlier Mystères were painted in what became standard pre-Six Day War IDF/AF camouflage. The same happened to the Super Mystère fleet upon the arrival of Mirage IIIs.

Major Daniel 'Danny' Shapira, the IDF/AF test pilot, joined No. 105 Sqn pilots during their Super Mystère conversion with Armée de l'Air unit EC 1/10 at Creil in 1958.

horrible experiences. The first was a 40-kt crosswind when we landed at Brindisi. The French leader asked 'Yak' if the kid would do it, and 'Yak' answered that he would do it better than the others! The second time was when we landed at Brindisi in good weather. Next morning there were eight oktas of clouds, rain, wet runway, low cloud base and they told me that we were flying! I said to 'Yak', 'Are you crazy?' and he answered, 'Ilan, join your leader in close formation, he'll get you out of the clouds, what do you have to worry about?' My leader took off and I immediately joined him in close formation. We entered the clouds at 600-700 ft and emerged at over 30,000 ft, and all that time I was suffering from vertigo! I had an awful feeling. I saw his silhouette and flew in close formation, and all the time I felt that we were rolling. I looked at the instruments – straight. I looked outside – rolling. We emerged from the clouds straight and level. It was a lousy feeling, a pilot has vertigo only three or four times in his career ... all through the climb I felt it. I understood that it was just the feeling of rolling, that this was vertigo, and that I had to stick to him until we emerged from the clouds."

The other two sextets were ferried over the same route on 5-6 January 1959 and on 22-23 January 1959, and after the option was exercised another six Super Mystères arrived in Israel later in 1959. While in Israel, and still waiting for the delivery of the Super Mystères, No. 105 Squadron pilots flew the Mystères of No. 101 Squadron and Major Nevo was even credited with an EAF MiG-17 kill in December 1958. Super Mystère flights in Israel began on 11 February 1959. In that same month it was decided to send two No. 105 Squadron pilots on a French Nord 5103 air-to-air missile course. In May 1959 Captain Lev and Lieutenant Aaron 'Yalo' Shavit attended the course in Algeria, and the 40 Nord 5103 AAMs which had been purchased in a September 1957 contract arrived in Israel in March 1960. However, No. 105 Squadron Super Mystères never became fully operational with the Nord 5103 AAM. The first Israeli test launch was not until 29 October 1962, and it was a failure. Although its days as the IDF/AF top interceptor were over by 1965, in December of that year a decision was made to equip 12 Super Mystères with the Rafael Shafrir AAM. Compatibility tests were performed by Super Mystère 12 but, like the Nord 5103, the Shafrir was not a success.

Super Mystère's public debut

The public debut of the IDF/AF Super Mystères came on Israeli Independence Day – 11 May – 1959 but their combat debut six months later was not impressive. On 4 November four Super Mystères led by Major Nevo engaged EAF MiG-17s but No. 3, Captain Ivry, entered a spin and had to eject. Although the pilot was retrieved by an S-58 helicopter, the air combat had to be prematurely terminated and a minor embarrassment was caused to the Super Mystère pilots. The cause of the loss was related to the fact that Captain Ivry had not jettisoned his external fuel tanks.

A series of inconclusive aerial engagements against both Egyptian and Syrian MiG-17s followed in 1960. The tension along the Syrian border resulted in a Quick Reaction Alert (QRA) detachment sent to Ramat-David on 24 September 1960, but soon after the Super Mystères returned home to Hatzor. Finally, on 28 April 1961, the IDF/AF Super Mystères scored their first air-to-air kill, even though it was no more than equalising the score with the EAF El Arish-based MiG-17s. The EAF MiG-17 was not shot down by cannon fire, but it entered a spin while being chased by Lieutenant Ron and the EAF pilot ejected. Ron recalled:

"Both the controller and I made errors. The MiG-17s patrolled their side [of the border] and we patrolled our side. Suddenly the controller told me, 'They are crossing the border.' He gave me a heading and told me that they were at my one or two o'clock, and then he added 'crossing you from right to left.' He was wrong and I acted without his approval because I understood that they were crossing me now, that he was talking about the present. I did not see [the MiGs] so I turned. When I completed the 90° turn he told me, 'Six o'clock, three miles!' 'You madman! At my six o'clock?!?'

"Obviously, we broke. When we broke, Lieutenant Zur Ben-Barak entered a spin. They (the MiGs) left him and went after me but I managed to close on their number 2. He also broke hard and entered a spin. He ejected. There were Yugoslav UN observers on the ground and they returned him to the Egyptians. Then I said, 'I am going after their number 1,' while (Lieutenant) Ben-Barak emerged from his spin, but [Major General] Ezer [Weizman] said, 'No! One is enough, return home,' so we returned home, but I was not credited with a kill."

Lieutenant Ron was flying Super Mystère 33 on that mission. The unit CO Major Shimon Ash – who had succeeded Major Nevo on 12 February 1961 – was scrambled twice in Super Mystère 35 on the same day (28 April 1961) to intercept EAF MiG-17s, but without results. Another two inconclusive air-to-air engagements against EAF MiG-17s occurred during 1961, and on 21 March 1962 the Super Mystères inconclusively engaged SAF MiG-17s. Less than a month later the first Mirage IIIC interceptors arrived in Israel, and the glory days of No. 105 Squadron as the IDF/AF's top fighter unit were over.

When the first two Mirage squadrons achieved Initial Operational Capability (IOC) in December 1962, No. 105 Squadron became

Despite this impressive ammunition display, the original Super Mystère had quite a restricted load capability since the two inner stations of its four hardpoints were almost invariably occupied by external fuel tanks.

The Super Mystère used both airbrakes and a braking parachute to shorten its excessive landing roll – a problem with almost every fighter designed in the 1950s. It was the first time that an IDF/AF single-engined jet had been so-equipped, though this feature was later also retrofitted to the Mystères.

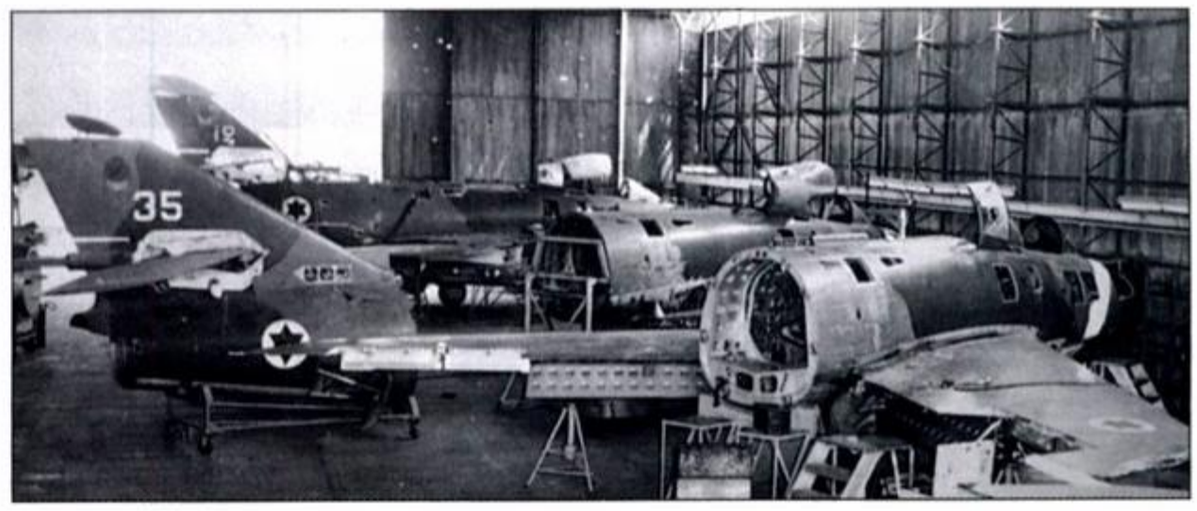
second best. Nevertheless, the Super Mystères were retained in five-minute QRA as a back-up to that of the No. 101 Squadron Mirage until August 1964, when No. 105 Squadron was relaxed to 15-minute QRA. The Super Mystères became multi-role combat aircraft and acted as a lead-in fighter type for young fighter pilots who were eager to convert to the Mirage as soon as possible.

A command crisis occurred in the late summer of 1962 when Major Ash informed the IDF/AF CO, General Weizman, of his intention to leave IDF/AF service and join EL-AL, the Israeli national airline, after completing his tour of duty as the No. 105 Squadron commander. The furious General Weizman failed to persuade Major Ash to change his plans so, in typical Weizman style, he ordered Major Ash to leave the IDF/AF immediately and even banned him from flying as a reservist (a decision which was changed only after the Six Day War). It was intended as an example to other IDF/AF pilots, to deter them from leaving the service in favour of the better salary offered by EL-AL. Captain Shadmi took over as acting commander of No. 105 Squadron until Major Lev was nominated the No. 105 Squadron commander in December 1962. In his turn, Major Lev was succeeded by Major Shlomo Bet-On in November 1963.

The first air-to-ground operation by the IDF/AF Super Mystères came on 13 November 1964 when Major Bet-On led Lieutenant Ehud Hankin to attack Syrian ground troops. In the same month, discussions were held about the possible conversion of No. *** Squadron at Ramat-David from the Mystère to the Super Mystère, which would be dependent on the purchase of additional ex-Armée de l'Air aircraft. Since the purchase of a large quantity was expected, No. *** Squadron pilots were converted to the Super Mystère at Hatzor by No. 105 Squadron in early 1965.

The No. 105 Squadron order of battle on 23 August 1966 included 19 serviceable Super Mystères and 21 pilots. No. 105 Squadron lost a dozen Super Mystères between 1959 and 1966, compensated for by the supply of six ex-Armée de l'Air Super Mystères in March 1960 and another six in June 1960. By the time Major Shavit succeeded Major Bet-On as the squadron's new commander in June 1966, No. 105 was at a low ebb following a series of accidents, most of which were caused by the Atar 101G-2 engine.

In September 1966 Major Shavit was fortunate to test the air-to-air combat skills of the Super Mystère against the ex-Iraqi Air Force MiG-21, in which Captain Monir Radfa had defected to Israel the previous month. The MiG was flown by Lieutenant Colonel Daniel Shapira. It became apparent that as long as the combat was at low altitude, the Super Mystère was able to cope with the MiG-21; however, the MiG had an advantage at higher altitudes and in its ability to use the vertical dimension better than the earlier-generation French fighter. This experience was to help Major Shavit when, less than a year later, he was in combat for real against SAF MiG-21s.



Right: No. 105 Sqn Super Mystères were maintained by the IDF/AF Air Maintenance Unit at Tel-Nof, where this photo was taken in about 1966. The type was maintained by IAI if required, the company also having a contract to maintain Armée de l'Air aircraft.

Five kills on 5 June

By the time of the emergency period that preceded the Six Day War, No. 105 Squadron was the largest IDF/AF fighter unit and efforts were being made to obtain yet more Super Mystères. On 6 April 1967 a contract was signed for the lease of six Armée de l'Air Super Mystères, the first four of which arrived in Israel on 20 April and the remaining two the next day. It is claimed that these aircraft were returned to France after the end of hostilities, although several of the leased aircraft were lost in combat and replaced by others. It is also claimed that other Armée de l'Air Super Mystères undergoing routine periodic maintenance by IAI were committed to the IDF/AF war effort, and likewise were also returned to France after the war. A request for another 25 Super Mystères was forwarded to France on 18 May 1967 but with unknown results. Hence, by 5 June No. 105 Squadron was composed of a cadre of very experienced combat pilots – mostly reservists and emergency posting (EP) pilots – plus young and inexperienced pilots, under the command of Major Shavit, and allegedly having a peak number of 39 serviceable Super Mystères.

The exact D-Day and H-Hour of the operation was top secret, so during the period preceding the war the pilots of No. 105 Squadron held a lottery about the day and hour on which the war would begin. It was won by Lieutenant Colonel Ya'acov 'Yak' Nevo, who was supposed to succeed Lieutenant Colonel Binyamin Beni Peled as the Hatzor air base CO and in the meantime flew on EP with the squadron he had reformed in 1958. The EP was a concept under which combat pilots and navigators either on staff duty or flying as instructors with the FS continued to fly with their previous fighter units for one day every week.

The targets of No. 105 Squadron during the first wave of Operation Moked (Focus) – the IDF/AF attack on the Arab air forces on 5 June 1967 – were the EAF Abu Sueir, Inchas and Kabrit air bases, although one of the formations bound for Inchas mistakenly attacked Cairo International Airport. Thirty-nine Super Mystères were dispatched by the squadron during the first wave and, of these, three failed to return to base, all three pilots being killed.

Kabrit, which housed the EAF's No. 31 Squadron equipped with MiG-17s, was the target of the first No. 105 Squadron formation, Time over Target (ToT) was 07.45, Israel local time. The leader was Captain Alexander Armon, his wingman was Lieutenant Colonel Nevo, Lieutenant Zvi Umschweif (reserve) was the sub-leader and his wingman was Lieutenant Amiram Manor. The formation bombed the runway with the new IMI/MATRA runway-piercing bombs and then strafed the EAF aircraft. During the strafing passes an Il-14 which came in to land at Kabrit was shot down by Captain Armon. Another Il-14 was encountered by the Super Mystères on their way home and it, too, was shot down, this time by Lieutenants Umschweif and Manor. Almost out of fuel and ammunition, the formation was then intercepted on its egress by EAF MiG-21s

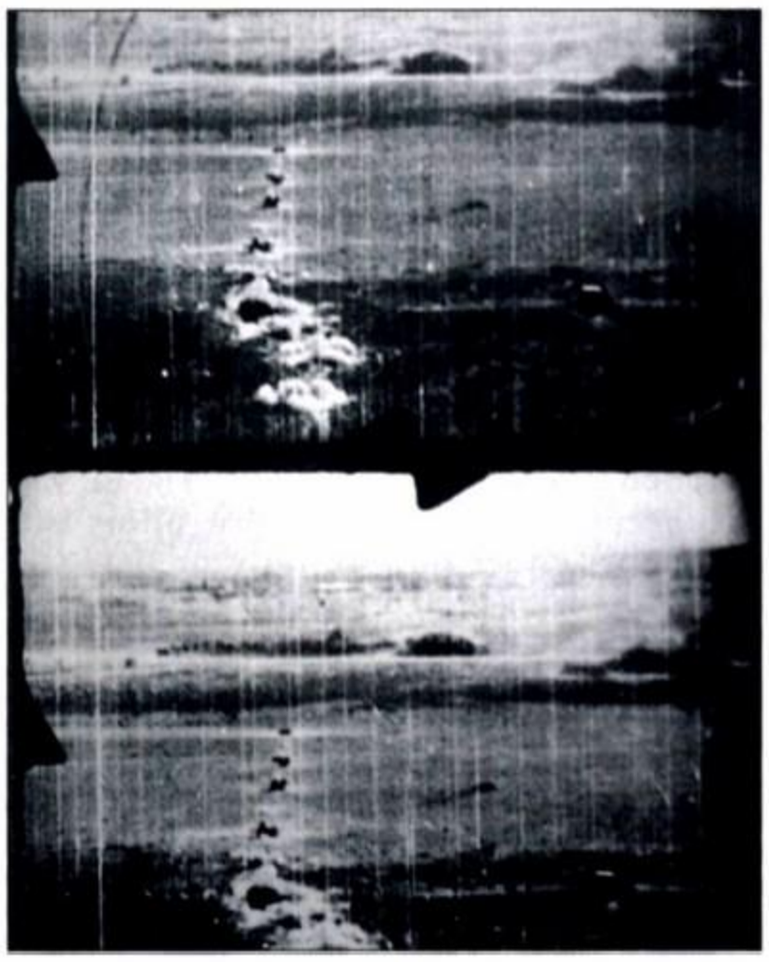
Super Mystère 94 was probably one of the leased Armée de l'Air examples operated by No. 105 Sqn during the Six Day War. When the dark pre-1967 camouflage scheme was applied over the original natural metal finish, the unit badge was not reapplied and the serial number remained on the nose.

Unit Heritage

Right: Super Mystère s/n 708 in the pre-Six Day War scheme. Note that the external fuel tanks with which the Super Mystères almost invariably flew were not painted and were left in their original metal finish.

Below right: The famous 'eights' at Abu Sueir air base are seen here with at least five Il-28s apparently still intact.

Below: A Super Mystère gunsight view of a BAI mission during the Six Day War.



which claimed two of the Super Mystères. Captain Armon was killed and Lieutenant Manor ejected, but his body was found when the war ended; he had been murdered by local Bedouins.

The second formation to attack, with a ToT of 08.00, was led by Major Shavit and its target was Inchas, a MiG-21 interceptor air base which had been attacked by a Mirage formation at 07.45. The local AA defences were already on alert and as the Super Mystères climbed for the bombing run Captain Dan Engel – No. 3 in the formation – received a direct AA hit and his aircraft exploded in the air before he released his bombs. During the ensuing strafing passes Major Shavit's Super Mystère was also damaged by the intense AA fire, but he made it back to Hatzor for an emergency belly landing.

Both at Inchas and at Kabrit the first Super Mystère formations were followed by another. The second one to attack Inchas bombed the runways with general purpose (GP) 250-kg bombs and claimed the destruction of seven MiG-21s on the ground during their strafing passes. Flying as No. 4 in that formation was Captain Shamuel Gordon, a future No. 105 Squadron commander.

MiG-17 air-to-air kill

The formation which attacked Kabrit even claimed a MiG-17 as an air-to-air kill when a MiG-17, which had just taken-off and still had its undercarriage extended, fell victim to the 30-mm cannon fire of the leader's wingman. Captain Shlomo Shapira – the squadron's operations officer – was originally planned to fly as No. 3 in Major Shavit's formation to Inchas. However, when the additional leased Super Mystères arrived he got his own formation and in Super Mystère 25 led a three-ship to attack Kabrit. In his three strafing passes, Captain Shapira claimed two MiG-17s and a single Mi-6. Another No. 105 Squadron formation attacked Abu Sueir during the first wave.

The first wave was pre-planned but the second was mostly intended to exploit to the full the success of the first, so formations were sent to air bases where targets were extant. During the second wave the Super Mystères attacked Inchas – where SA-2 SAMs were launched against them – and Mansurah, as well as the radar station at Aj'lun, Jordan, which was monitoring IDF/AF activity. Captain Shlomo Shapira in Super Mystère 10 led a formation to attack Abu Sueir, where he only claimed a single Il-28. He recalled: "My second sortie that day was to Abu Sueir with its famous 'eights' [aircraft dispersals in the shape of 'figure-eights']. We bombed the runways and then looked for aircraft. My feeling was that most of the aircraft had already been hit. We made three strafing passes and in the last one I even strafed an aircraft that was preserved on a stand!"

When Jordan and Syria joined the hostilities the third and fourth waves also included attacks on Royal Jordanian Air Force (RJAF) and SAF air bases. During the third and fourth waves, No. 105 Squadron attacked Mansurah in Egypt, and Dmeir, Marj' Real and Zaikal in Syria. The first formation to attack Marj' Real was led by Captain Ilan Ron (reserve), who recalled the mission.

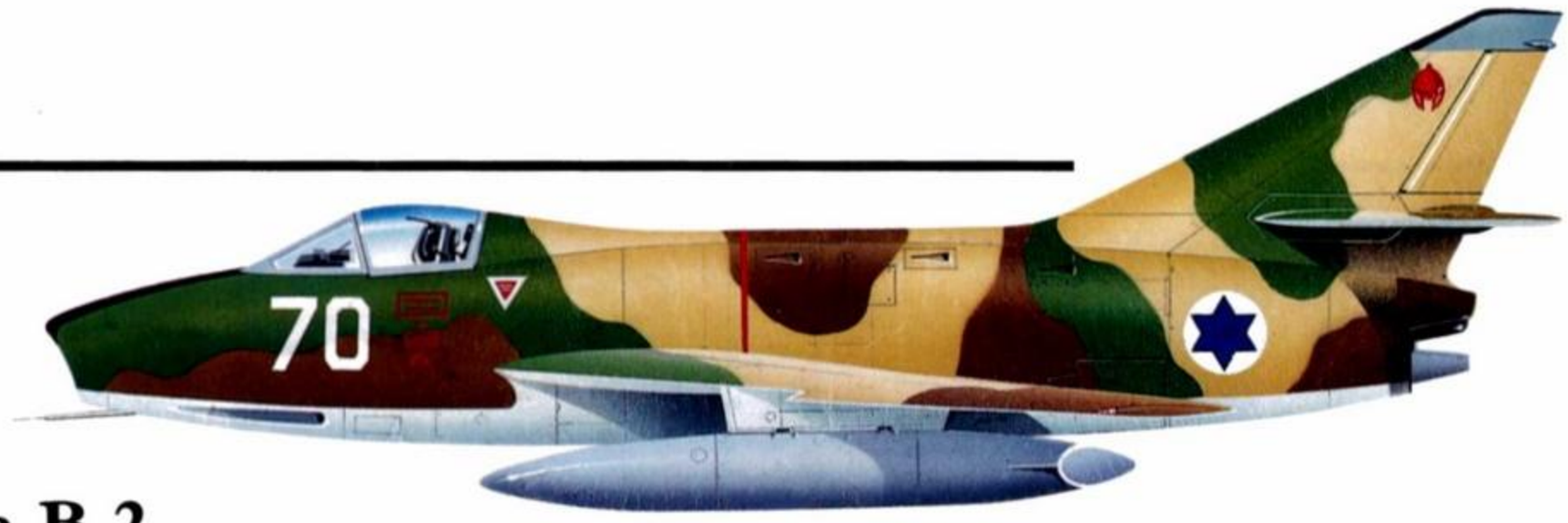
"We had packs of maps. I was waiting at the HAS to lead a quartet to attack Inchas when suddenly I was told, 'No, no, you are going to Marj' Real.' I replied, 'Where is it? At least tell me in which country!'

"It was not a large airfield but there were a lot of MiG-17s. They were completely surprised. We bombed the runway and then strafed. We used to do three strafing passes but I said, 'Let's stay until we will finish all the MiGs!' Apparently there was a quartet of Ouragans above us, waiting their turn. They had no radio contact with us so they counted three strafing passes and came in to bomb. They thought that we were getting out but we didn't! Oh, what a mess!"

A Super Mystère was lost at Dmier: its pilot, Captain Dan Sigri (reserve), ejected but was killed on the ground by locals. At Zaikal a formation led by Major Shavit was intercepted by a pair of MiG-21s, but the unit CO utilised the experience he had gained during DACT against the ex-IrAF MiG-21 in 1966. No. 3 had to disengage due to a fuel leak so Major Shavit engaged the MiG-21 wingman and the two Super Mystère wingmen engaged the MiG-21 leader. Remaining at low altitude and avoiding the vertical dimension, the Super Mystères held their own against the MiG-21s and both were claimed as air-to-air kills, one by Major Shavit and one by his wingman Sub-Lieutenant Yirmiyahu Keidar.

No. 105 Squadron was almost twice as large as other IDF/AF fighter squadrons and it undertook a total of 128 combat sorties on 5 June 1967. Four aircraft were lost and four pilots killed, the heaviest losses sustained by a single IDF/AF squadron during Operation Moked. Even the unexpected success of the

Super Mystère 27 was burnt-out on the ground on 10 March 1963 after a mechanic working on Super Mystère 62 accidentally fired one of its cannon, which had not been electrically disconnected as per normal procedure.



Standard IDF/AF camouflage was applied to the Super Mystère fleet upon the arrival of the first Mirage III, as the type was concentrated in the ground-attack role. As the sole operator of the type, No. 105 Squadron had a sizeable fleet, which may have included (unofficially) Armée de l'Air aircraft.

Super Mystère B.2

Super Mystère in air-to-air combat, with five kills, could not offset the pain caused by the losses, but No. 105 Squadron's war was not over yet.

Following the achievement of complete air supremacy in Operation Moked, the IDF/AF was able to support the IDF ground forces almost without challenge. No. 105 Squadron began ground attack missions on 5 June while Operation Moked was still underway. Captain Shlomo Shapira's fourth sortie that day was to drop leaflets over El Arish from special canisters and then attack an Egyptian headquarters and vehicles in the area of Bir Lachfan and Jabel Libni. When darkness fell, the Jordanians began to attack targets in Israel – including Tel Aviv – with their artillery and to move armoured forces from Jericho to Jerusalem. No. 105 Squadron launched its Super Mystères to counter both threats. Major Shavit flew two sorties to attack the Jordanian artillery and Captain Shlomo Shapira attacked the Jordanian armour east of Jerusalem. Flares were used in both cases.

Syrian targets

The next day – 6 June – opened for Captain Shlomo Shapira with a very successful attack mission on the notorious Syrian upper customs house strongpoint. His next mission was to attack Syrian artillery at El-Al and then he switched his attention to the Egyptian front, where he flew a BAI mission as No. 3 in a formation led by Captain Giora Oren, No. 105's first deputy commander. The other pilots in that formation were Lieutenant Ron Holdai and Lieutenant Gadi Aviram.

Two Super Mystères were lost that day. Lieutenant Eli Zohar, shot down by an Egyptian SA-2 during a CAS mission, ejected safely, joined the IDF ground troops and was returned to Hatzor by a Sikorsky S-58. Less fortunate was Lieutenant Yair Barak, who was shot down near Kseimeh in Sinai. He was taken a POW by the Egyptians and was returned home to Israel only on 23 January 1968.

On 7 June another Super Mystère was lost in the Sinai but the pilot was retrieved. Lieutenant Ig'al Shochat was shot down during air combat with EAF MiG-17s near Bir Gafgafa. Two of the EAF MiG-17s that participated in that air combat were later shot down by IDF/AF Mirages that were diverted to the area, but it was too late for Lieutenant Shochat. Luckily, Lieutenant Shochat ejected successfully, joined the IDF 60th Brigade and was then flown back to Hatzor in a S-58.

8 June was the only day during the war on which No. 105 Squadron lost no aircraft, although it flew ground-attack missions on all three fronts. In the second of his three missions that day, Captain Shlomo Shapira led Captain Nisim Ashkenazi, Captain Eliezer Magid and Captain Ben-Zion Gaifman to attack Egyptian armour between Bir Gafgafa and Ismailiya. The four Super Mystères spotted EAF Su-7s and turned into them, but the Su-7s escaped. A notable mission that day was the attack in error against the US 6th Fleet spy ship USS *Liberty* by a pair of Super Mystères.

On the last two days of the war the squadron concentrated on attacking Syrian forces in the Golan Heights. Two Super Mystères and their pilots were lost in these missions, one on each day. On 9 June Lieutenant Colonel Shlomo Bet-On – a former No. 105 Squadron commander and then the Hatzor air base Flying Squadron CO – flew with No. 105 Squadron on EP. His Super Mystère was hit by AA fire and he was probably trying to fly west toward Israeli territory when his aircraft crashed. The next day Captain Gaifman was killed in similar circumstances.

Nine losses

Nine Super Mystères were lost during the Six Day War. Six pilots were killed, one became a POW and two were retrieved. These were the highest number of losses sustained by any one of the nine IDF/AF fighter squadrons, but it must be remembered that No. 105 was a relatively large unit. The Super Mystères performed well during the war and were even credited with five confirmed kills: two SAF MiG-21s, two EAF Il-14s and a single EAF MiG-17.

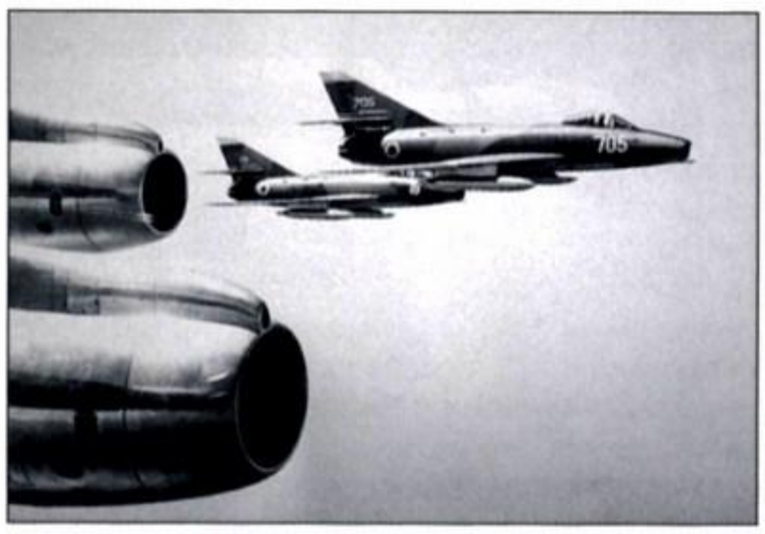
Just one month after the end of the Six Day War, No. 105 Squadron returned to flying operational missions. On 15 July 1967 Captain Shlomo Shapira attacked Egyptian artillery at Ismailiya in Super Mystère 46. The attention of No. 105 Squadron was then turned to the Jordanian border, where it attacked various targets on 20 November 1967, in January 1968,

Above: Maj. Aaron Yalo Shavit was No. 105 Sqn's commanding officer from 1966-68.

Below: Capt. Shlomo Shapira, No. 105 Sqn operations officer, poses for the camera in the cockpit of Super Mystère 10 in 1967. Between 1973 and 1974, Lt Col Shlomo Shapira commanded the 'Scorpions'.

The end of the war! No. 105 Sqn pilots fire their pistols to mark the end of the Six Day War. Spitfire 2038, painted as '105', may be seen in the background.

Super Mystère 12 taxis in the summer of 1967 at Hatzor in front of the large sun shelters which had been used by IDF/AF Mosquitos during the 1950s. This aircraft is notable in that it was used in compatibility testing for the Rafael Shafrir 2 AAM. It was later upgraded to Sa'ar standard and ended its days in Honduras (as FAH 2010), where it was scrapped in 1987. (Honduras withdrew and stored the last of its Sa'ars in 1996, but in 1998 announced plans to reactivate a handful.)



'Scorpions' Super Mystères 705 and 18 escort an EL-AL Boeing 707 conveying Israeli President Itshak Ben-Zvi on 29 July 1962. As the first Mirage IIIs had arrived in April, this photo would suggest that these two aircraft were among the first of their type to be painted in the pre-Six Day War two-tone camouflage scheme.

on 21 March 1968, on 4 June 1968 and on 4 December 1968. In the last mission, Lieutenant Nadav Nehorai's aircraft was hit by AA fire near Irbid. Lieutenant Nehorai ejected but was killed on the ground.

In 1968, as the Super Mystères started to show their age, the French embargo began to take its toll. Several aircraft were lost in accidents and maintenance became increasingly difficult. As a result, in August – the same month in which Lieutenant Colonel Oded Sagi succeeded Lieutenant Colonel Shavit as the commander of No. 105 Squadron – a proposal to upgrade the Super Mystère was presented to the IDF/AF CO Major General Mordechai 'Moti' Hod. The heart of the proposition was the replacement of the French SNECMA Atar 101G-2 engine by the American Pratt & Whitney J52-P-8A, which offered both logistic and operational benefits.

Logistically, the J52 was the powerplant of the A-4 Skyhawk which at that time was entering IDF/AF service in large numbers, and it was more reliable than the Atar and required less maintenance. From an operational point of view, the engine replacement was a most promising proposition. Weighing 960 kg (2,116 lb), the American turbojet was lighter than the Atar's 1230 kg (2,711 lb). The dry thrust of the J52 was 41.37 kN (9,303 lb), compared to 33.33 kN (7,495 lb) for its French counterpart, and not much lower than the thrust of the Atar with afterburner, which was 44.12 kN (9,920 lb). The specific fuel consumption (SFC) of the J52 was 0.86 versus 1.1 for the Atar without afterburner and 2.0 with afterburner. Its only drawback – purely from a fighter pilot's point of view – was the lack of afterburner, but this was more than offset by the saving of weight, the reduction of SFC and the significantly higher dry thrust.

The engine replacement also required structural changes, such as the lengthening of the rear fuselage to keep the centre of gravity (C of G) at its original limits, so IDF/AF engineers proposed taking advantage of the engine change to incorporate further modifications. The programme became not only an engine replacement but a complete upgrade, aimed at optimising the aircraft for the attack mission since no significant changes had been incorporated into the design when its main role was changed from air-to-air to air-to-ground in the early 1960s. The original gunsight was replaced by an Israeli El-Op electronic gunsight. The wings were reinforced so that two more hardpoints could be added near the fuselage, wired for the Rafael Shafrir 2 IR AAM. Since France embargoed their spares supply, the aircraft's systems were also replaced with American and Israeli equivalents.

The project was immediately approved and that month Super Mystère 09 was transferred to IAI to be converted as a prototype. Lieutenant Colonel Daniel Shapira made the first flight of the improved Super Mystère on 13 February 1969 and on 28 February the 'new' fighter was presented to the staff of the IDF GHQ and the IDF/AF AHQ. Test flights followed during 1969 while other Super Mystères were transferred to IAI for conversion. The first serial conversion Improved Super Mystère was delivered to No. 105 Squadron in December 1969.

Attacks on Jordan resume

In early 1969 the squadron resumed its attacks on Jordan. On 23 February the Arandal police station was attacked, on 13 April the PLO Chairman Yasser Arafat was attacked at Carameh by a pair of Super Mystères but he escaped unhurt, and on 27 July they attacked at night a Syrian artillery convoy in northern Jordan. In July the Attrition War on the Egyptian front began and No. 105 Squadron had to divide its attention between the Egyptian front and the Jordanian border; all the while it was under strength, as at any given moment several of its aircraft were being upgraded.

The Attrition War formally opened on 20 July 1969 when the IDF/AF launched Operation Boxer, a concentrated effort to attack Egyptian targets along the Suez Canal, which lasted for several days. From that month until the Attrition War ended in August 1970, No. 105 Squadron regularly flew attack missions along the Suez Canal.

Major Ezra Aharon (reserve) joined No. 105 Squadron in August 1970 and flew both the Super Mystère (aircraft 60 and 93) and the Improved Super Mystère (aircraft 02, 08, 09, 25 and 49). As he recalls, "Outside it was the same aircraft, but inside it was completely different. At low altitude the non-afterburning (J52) engine had almost the same power as it had with the afterburning (Atar) engine, and with an SFC of less than half at such low altitude, it was a very good aircraft. The (J52) engine was a

Super Mystère 09 became the Sa'ar upgrade prototype and was first flown by Lt Col Daniel 'Danny' Shapira in February 1969. Here the extended tailpipe necessitated by the J52 is readily apparent.

Sa'ar 80 takes off on an attack mission during the Yom Kippur War with eight 100-kg bombs, two 600-litre external fuel tanks and a a pair of Rafael Shafrir 2 AAMs.

lot better and more reliable than the Atar. Apart from its extraordinary SFC it gave much better performance at low altitude. Because of the (J52) engine the nozzle was lengthened by a metre or so and the convergent/divergent nozzle was deleted. The weapon system was completely changed. [Two] hardpoints were added as well as a [new] weapon system with [weapons] stations selection. If I am not wrong it could carry 16 [100-kg] bombs ... it carried a lot of bombs and this was its [new] role. At low altitude it was an excellent aircraft but compared to the Super Mystère it was pretty sluggish at high altitude, and in air combat there was nothing to compare to the [original] Super Mystère."

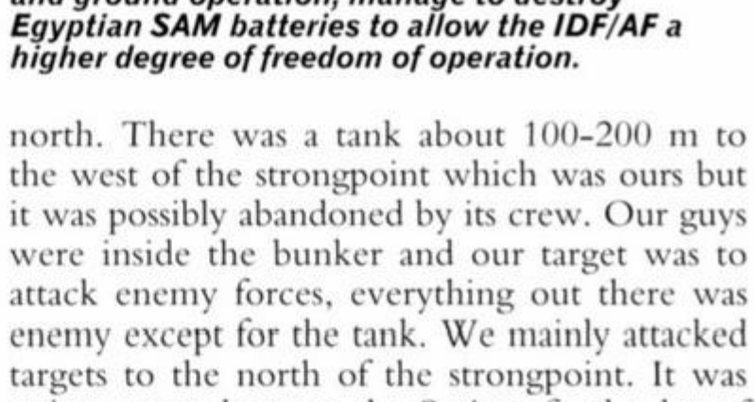
The end of the Attrition War allowed No. 105 Squadron to complete its transition to the Sa'ar (Storm) – as the Improved Super Mystère became known – in a more relaxed manner. In 1972 the last Super Mystères left the squadron and the final series Sa'ar conversion was delivered to the unit in June 1972. A total of 24 Super Mystères was converted to Sa'ar standard by IAI between 1969 and 1972, plus the 'prototype' (aircraft 09) and 96, which was damaged in an accident as a Super Mystère and brought to Sa'ar standard during its lengthy refurbishment. In 1973 the Sa'ars appeared in public for the first time, initially during the Independence Day flypast in May when a formation of 22 Sa'ars was flown and then on IDF/AF Day on 12 July. A far more significant show followed in October when No. 105 Squadron was once again committed to war when the Yom Kippur War broke out on 6 October 1973.

The Sa'ar in combat

. At the peak of its strength during the Yom Kippur War in October 1973, No. 105 Squadron had 52 pilots and 25 aircraft. Several of the pilots were very experienced reserve pilots, such as Ezra Aharon and Ilan Ron; others were young pilots who had just been declared operational, while the unit also had several very young pilots who had not been declared operational. This situation allowed the squadron commander, Lieutenant Colonel Shlomo Shapira, to fly 31 operational sorties during the war, knowing that he could rely on the veterans who managed the unit while he was away for the two hours or so of the mission. It also reduced the strain imposed on the leaders, since in each formation at least two very experienced pilots were included so the leader did not have to concentrate on all the aircraft. The younger pilots were dispatched on operational sorties in a controlled manner which gave them more chances to survive and obtain vital experience. For example, they were not sent on the first formations of the day. When these morning missions returned the pilots described the situation around the targets, especially the weather and SAM threats. Only then was it decided whether or not to dispatch the younger pilots on the next operational sorties. In any case, pilots were eager to fly and they put a lot of pressure on the fight 'managers' to include them in the 'waiting list' for operational sorties.

To Lieutenant Colonel Shlomo Shapira, it was clear on 5 October that war would break out the next day. It was Friday, but the unit's air and ground crews were not allowed to return home for the weekend as usual. The reserve pilots had been called and ordered to arrive early on Saturday morning, but there was no clearance yet to call the reserve ground crews. In the morning briefing on Saturday, 6 October, the pilots were told about the planned IDF/AF pre-emptive strike. The targets were mostly Syrian air bases because weather did not permit a pre-emptive strike on the Syrian SAM network. The formation which Lieutenant Colonel Shlomo Shapira led was tasked to attack the distant T-4 air base, so the aircraft were in long-range configuration with large 1300-litre (286-Imp gal) external fuel tanks. ToT was about 11.00 but after the pilots left for their aircraft the operation was abruptly cancelled, since the Israeli government decided not to launch a pre-emptive strike. The ground crews were busy changing the configurations of the Sa'ars from air base attack to mostly CAS. The large external fuel tanks were removed, some aircraft were fitted with smaller external fuel tanks, others had no external fuel tanks, while a few aircraft were in asymmetric configuration of one smaller fuel tank and 14 bombs.

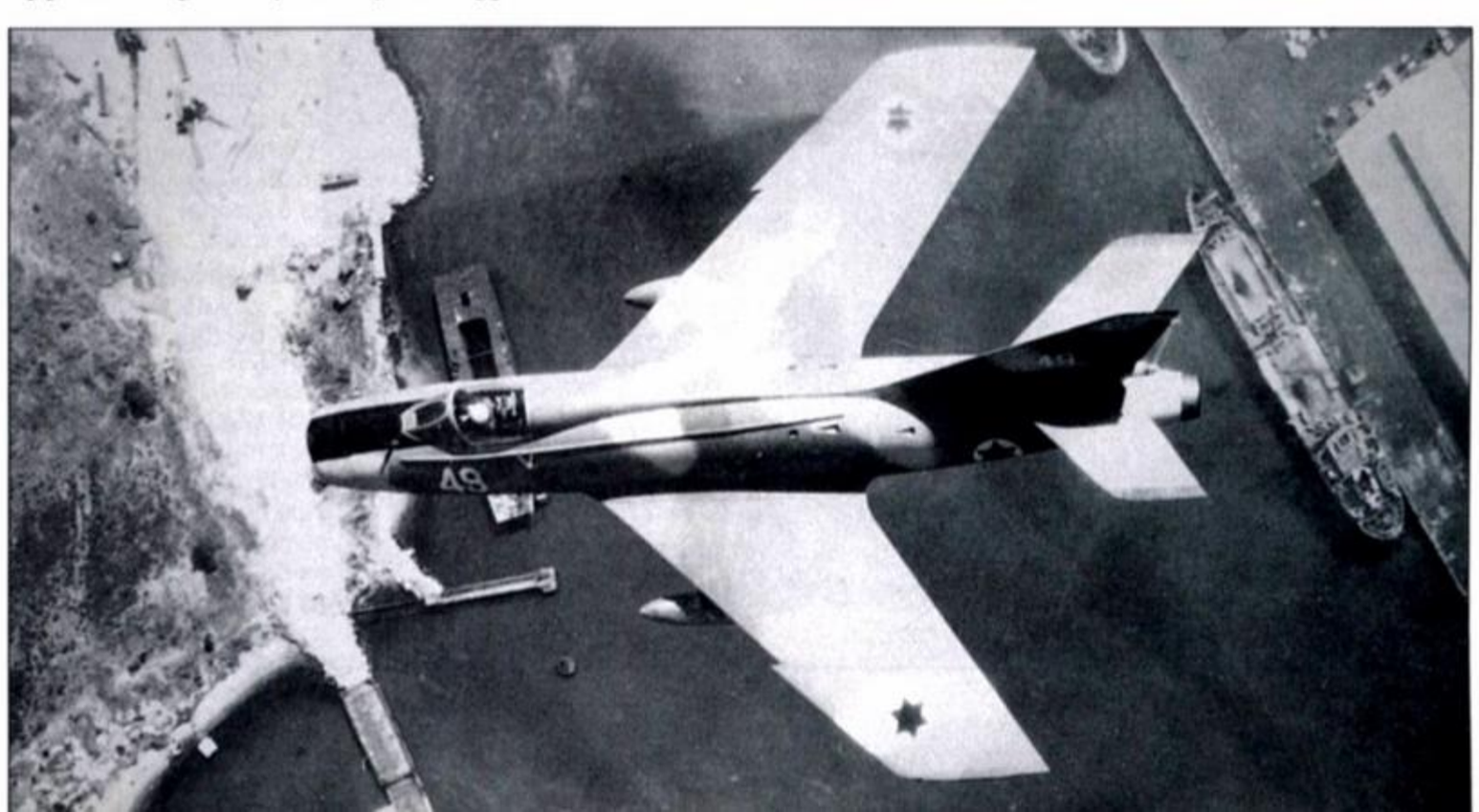
Lieutenant Colonel Shlomo Shapira's formation was the first to be scrambled, about 14.00. He recalled: "We were scrambled to the north and got as far as Netanya. We received a change of mission to rush [south] to the [Suez] Canal. We rushed to the Canal and got as far as Gaza and then the controller once again changed our heading. He frantically ordered us north to Mount Hermon. On our way it was explained to us that [Syrian] forces were approaching the [Israeli] strongpoint from the



Above: This is a typical scene over the Suez Canal during the Yom Kippur War. IDF/AF attack aircraft flew well within SAM range in support of hard-pressed IDF ground forces. Only in the later stages of the war did the IDF, in a combined air and ground operation, manage to destroy Egyptian SAM batteries to allow the IDF/AF a higher degree of freedom of operation.

north. There was a tank about 100-200 m to the west of the strongpoint which was ours but it was possibly abandoned by its crew. Our guys were inside the bunker and our target was to attack enemy forces, everything out there was enemy except for the tank. We mainly attacked targets to the north of the strongpoint. It was quite a mess because the Syrians fired a lot of mortars. There was a SAM threat. We tried to enter from the rear, pull up at the last moment and get out immediately. We knew that if a

Below: This is what remained of Sa'ar 18 after a take-off accident involving Lt Aviram Cohen on 7 October 1973.



In this view of a No. 105 Sqn Sa'ar a short time before the Yom Kippur War, external pipework on the fuselage may be clearly seen. The relocation of systems from the lower fuselage is claimed to have enhanced the survivability of the Sa'ars during the war.

During its entire IDF/AF career the Super Mystères were operated by the same unit from the same air base. No. 105 Sqn Sa'ar 82 lands at Hatzor with a No. 101 Sqn Mirage awaiting its turn to take off.

SAM was launched it would be difficult to detect it because of the clouds. My foursome returned safely and I think that we did some damage, but we did not save the strongpoint."

The next day four Sa'ars were lost. A formation was dispatched to attack Syrian armour on the Golan Heights but Lieutenant Aviram Cohen in Sa'ar 18 aborted his take-off attempt well after the recommended speed to do so was attained. The Sa'ar smashed through the braking net and skidded along the runway on its external fuel tanks, catching fire in the process. When the burning fighter finally came to a halt, the pilot escaped, but he was badly burned and the aircraft was a complete write-off. The leader of the formation waited for the reserve, Captain Doron Smadar, whose fate was even worse: Smadar's Sa'ar was shot down by a SAM and the pilot was killed.

The IDF/AF Museum's Sa'ar, 096, is not fitted here with the third inner hardpoint normally associated with the type, and carries small practice bombs. The ordnance displayed in front of the Sa'ar is too modern to have been carried by the upgraded French fighter.

Sa'ar losses over Suez

Another two Sa'ars were lost over the Suez Canal. Captain Itshak Kaidar was killed and Lieutenant Eli Gor – who was flying wingman to Major Ezra Aharon (reserve) – was shot down by a SAM and taken POW by the Egyptians. Just two more Sa'ars were lost, from which both pilots were retrieved. Each had an interesting story to tell.

On 11 October Lieutenant Lipsich was hit by Syrian AA fire. He managed to bring his damaged aircraft near Ramat-David, where he planned to perform an emergency landing, but the local Israeli AA defences opened fire at the strange-looking aircraft and Lieutenant Lipsich had to eject. Six days later, on 17 October, Captain Tamir (reserve) was hit by an Egyptian SA-6 and had to eject between Egyptian and Israeli forces. He was retrieved by the Israelis and driven to the local headquarters where – by pure chance – Minister of Defence Moshe Dayan and the commander of the southern front, General Chaim Bar-Lev (reserve), were visiting. The reservist pilot was welcomed by the general with the words, "Hey, soldier! Why don't you get a hair cut?"

During the conflict No. 105 Squadron lost just those six aircraft and, of the pilots, two were killed, one was injured, one was taken POW and two were retrieved. The unit's casualties were far less than that suffered by other IDF/AF attack squadrons, as Shlomo Shapira explains: "More or less, the squadron had the same missions as the A-4 Skyhawk squadrons. This aircraft had the advantage of speed. It was a lot faster than the A-4 even though it had the same engine, but the French aircraft was slicker. I think that this speed advantage helped with relation to AA hits. We had several SA-7 hits which damaged the empennage. When the [original French] engine was replaced the fuselage was lengthened and the end of the nozzle was further aft of the control surfaces, unlike in the A-4. When such a missile homes on the engine's heat it approaches about 1-2 m behind the end of the nozzle. Because of the lengthening [of the Sa'ar], this point was further aft. It kept [the missile] away from the control surfaces. It probably gave [us] an advantage. They gave the A-4 similar modifications during the war. [Another advantage was that during the upgrade] the hydraulics were repositioned on the upper fuselage. They were previously in the underside and were raised up, so they suffered less hits [from below]."

Lessons were learned quickly during the war, and one was to assign a specific area of operations to the attack squadrons. The Sa'ars got the Ras Masala area on the Egyptian front and operated there almost exclusively. The transfer of information about the situation at the squadron's theatre of operations was on two levels, in the air and back at the squadron base. Each formation leader on his egress briefed the next formation leader on his ingress. This was obviously restricted to urgent information and was confined to the squadron's radio channel so as not to disturb the command and control channels. After landing, all information was collected and distributed for the benefit of the squadron.

QRA at Ophir

A unique mission for No. 105 Squadron was the QRA detachment at Ophir air base near Sharem El-Sheikh on the southern tip of Sinai. The Sa'ars did not spend the night at Ophir so, early each morning before sun rose, a fully armed formation was dispatched from Hatzor. The aircraft arrived at Ophir just in time to perform a dawn patrol and then landed, taxied to the HAS and waited for the scramble – which usually did not come. The main purpose

No. 105 Squadron Commanders, 1950-1975

dates (if known)	name	subsequent history
Dec 1950	Capt. Menachem Bar	retired from IDF/AF as a colonel
Aug 1951	Maj. Yeshayahu 'Shaya' Gazit	retired from IDF/AF as a colonel
Mar 1952	Capt. Menachem Bar	(not known)
Apr 1953	Maj. Israel 'Tibby' Ben-Shachar	retired from IDF/AF as a lieutenant colonel
21 Mar 1954	Capt. Itshak 'Tsahik' Yavneh	retired from IDF/AF as a lieutenant colonel
30 Jul 1954	Maj. Moshe 'Monik' Tadmor	killed in Mustang on 31 October 1956
Nov 1956 - Jan 57	Capt. (res) Avraham Hachohen	retired from IDF/AF as a captain, killed as IAI chief test pilot when the Arava prototype crashed on 27 November 1969
20 Aug 1958	Maj. Ya'acov 'Yak' Nevo	retired from IDF/AF as a colonel
12 Feb 1961	Maj. Shimon Ash	retired from IDF/AF as a major, missing in action as a reservist in an A-4 Skyhawk on 7 October 1973
Sep 1962	Capt. Ohad Shadmi	killed as a lieutenant colonel in an F-4 Phantom on 6 March 1970
Dec 1962	Maj. Arlozor 'Zorik' Lev	missing in action as a colonel in an A-4 Skyhawk on 9 October 1973
Nov 1963	Maj. Shlomo Bet-On	killed as a lieutenant colonel in a Super Mystère on 9 June 1967
Jun 1966	Maj. Aaron 'Yalo' Shavit	retired from IDF/AF as a brigadier general
Aug 1968	Lt Col Oded Sagi	retired from IDF/AF as colonel
	Lt Col Aryeh 'Arik' Azuz	retired from IDF/AF as colonel
1973	Lt Col Shlomo Shapira	retired from IDF/AF as lieutenant colonel
31 Jul 1974	Maj. Shamuel Gordon	retired from IDF/AF as colonel

of the detachment was air-to-ground, with a secondary air-to-air capability. The Sa'ars were armed with Rafael Shafrir 2 AAMs and were expected to counter aerial threats, as it was clear that it would take too long for more advanced IDF/AF interceptors to arrive from the north. At the end of each day the formation returned home to Hatzor in a memorable 35-40-minute flight over a totally blacked-out country.

Having only one squadron operating the Sa'ar created a logistics problem. During the Yom Kippur War No. 105 had to detach seven technical teams to seven air bases, whose task was to prepare for a flight back to Hatzor any Sa'ar that might land at one of these bases for any reason, usually fuel shortage or battle damage. Naturally, this burden did not exist for the A-4 Skyhawk or the F-4 Phantom squadrons. To operate the Sa'ar, the IDF/AF had to preserve proficiency on the type not only at squadron level but also at base and depot levels. This became uneconomic and, as a result, the remaining 18 Sa'ars – one of the 19 that survived the Yom Kippur War crashed when Captain Amiram Shaked ejected during a night flight – were offered for sale.

At that time, Honduras was shopping for fighters and a delegation visited Israel. Though IAI chief test pilot Daniel Shapira demonstrated the aircraft to the visitors, the Israelis had yet to make a definite decision on the future of the aircraft. The same delegation had previously visited Yugoslavia, where they were offered the North American F-86E Sabre. Israeli indecisiveness prompted the Hondurans to purchase a batch of Yugoslav F-86Es, and only a small number (five) of Sa'ars.

It was decided to convert No. 105 Squadron to the F-4E Phantom, so on 31 July 1974 Lieutenant Colonel Shlomo Shapira handed over the command of the squadron to Major Shamuel Gordon, who had flown the Super Mystère in the Six Day War and the F-4E Phantom in the Yom Kippur War. Major Gordon was tasked with the mission of converting No. 105 Squadron from the Sa'ar to the Kurnass (Sledgehammer), as the F-4 is known in IDF/AF service. A single Sa'ar led the first five F-4Es of No. 105 Squadron to Hatzor on 31 March 1975. By the time No. 105 Squadron celebrated its 25th anniversary – 8 July 1975 – Shamuel Gordon had become a lieutenant colonel and the unit was back at the top as one of the IDF/AF Kurnass squadrons.

Shlomo Aloni

Editor's note

Although details regarding No. 105 Squadron's operations since 1975 are scarce, the activities of the IDF/AF in general in the last 23 years have been widely reported. No. 105 is believed to have received 24 F-4Es in early 1974. In actions in which IDF/AF F-4s are known to have taken part, including Operation Peace for Galilee in 1982 (and subsequent raids on Lebanese territory during the remainder of the 1980s), it seems probable that the 'Scorpions' took part.

The specialist aviation media also widely reported the unit's re-equipment in 1991 with General Dynamics F-16C Barak (Lightning) Block 40 aircraft. Examples of the indigenous Brakeet (Thunderbolt) F-16D SEAD variant in No. 105's markings have also been noted.

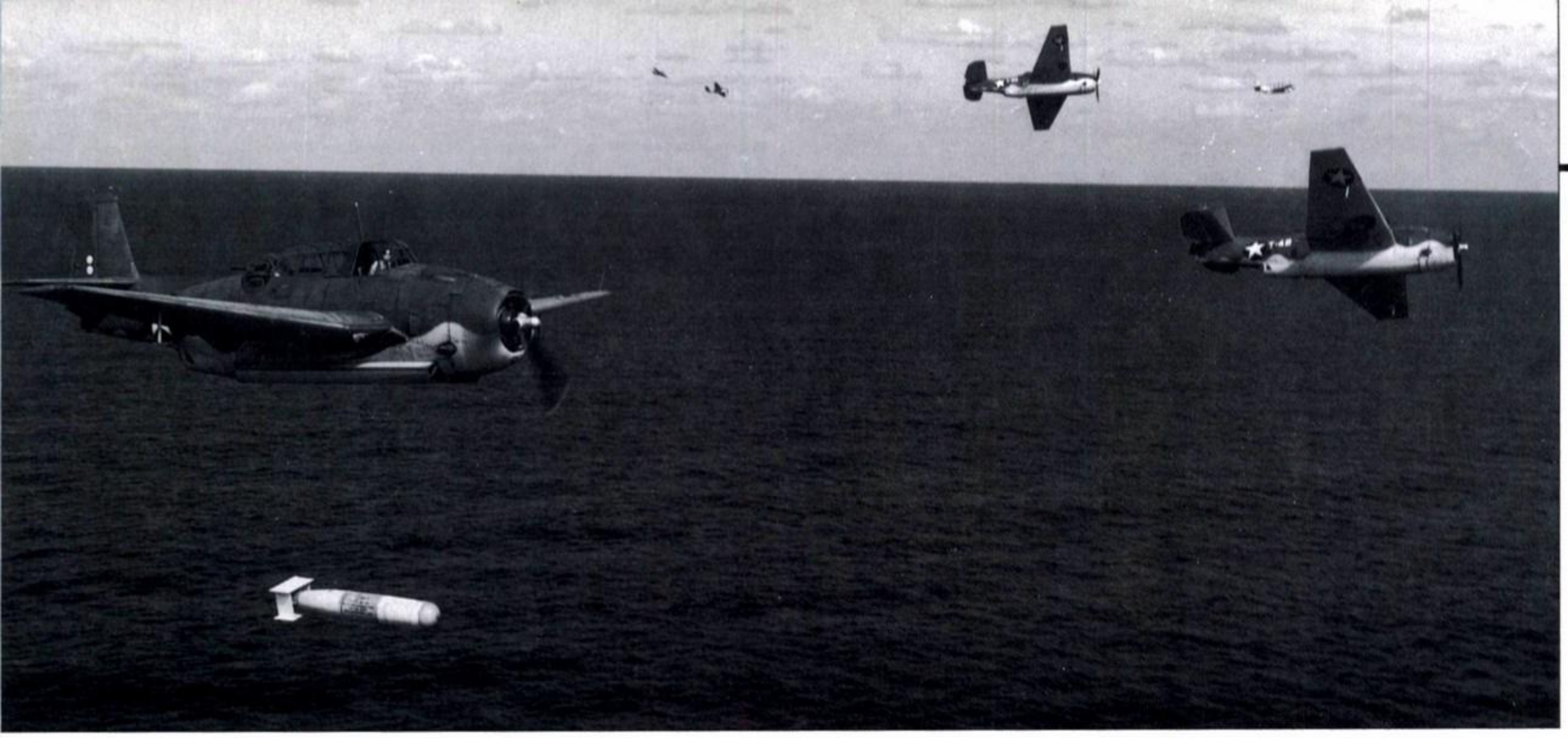
No. 105 Squadron Losses, 1950-1975

date	aircraft	pilot	circumstances
15 Jan 51	Spitfire 2044	Sub-Lt Gabriel Meir	pilot killed
19 Aug 51	Spitfire 2047	Lt Yoel Kosta	aircraft caught fire, pilot killed in unsuccessful bale-out
27 Nov 51	Spitfire 2021?	Sub-Lt Ya'acov Agassi	collision with Sub-Lt Shamuel Bavli, pilot landed in field
23 Sep 53	Spitfire 2025	?	aircraft written-off
4 Apr 54	Spitfire 2081	Sub-Lt David Ratner	pilot killed
1 Aug 54	Spitfire 2071	?	landing accident, aircraft written-off
3 Jan 55	Spitfire 2037	UBAF Than Win	engine cut after take-off, pilot killed
1 Jun 55	Spitfire 2063	Sub-Lt ?	pilot made successful emergency landing in a field
28 Sep 55	Spitfire 2060	Sub-Lt Amir Shapira	pilot killed
14 Feb 56	Spitfire 2075	?	aircraft written-off
17 Apr 56	Spitfire 2061	Har'el	take-off accident, aircraft written-off
12 Aug 56	Mustang 2367	Sub-Lt Chaim Niv	engine malfunction, pilot landed in field; aircraft written-off
4 Sep 56	Mustang 2371	Capt. Eldad Paz	engine malfunction, pilot landed in field; aircraft written-off
7 Oct 56	Mustang 2327	Capt. Eldad Paz	engine malfunction, pilot landed in field; aircraft written-off
14 Oct 56	Mustang 2334	Lt (res) Uri Leventhal	engine malfunction, pilot landed in field, seriously injured
25 Oct 56	Mustang 2344	Capt. (res) Alex Jacobs	aircraft crashed after take-off at night, pilot killed
31 Oct 56	Mustang	Sub-Lt Asaf Ben-Nun	shot down by AA fire, pilot landed in Israeli territory
31 Oct 56	Mustang 2336?	Maj. Moshe Tadmor	shot down by AA fire over Abu Ageila, pilot killed
31 Oct 56	Mustang 2319	Capt. Idad Paz	shot down by AA fire, pilot landed behind enemy lines, returned on foot
4 Nov 59	S. Mystère 30	Capt. David Ivry	entered spin during combat with EAF MiG-17, pilot ejected
29 Jun 60	S. Mystère 17	Sub-Lt Shamuel Hetz	collision with S. Mystère 16, pilot ejected successfully
10 Nov 60	S. Mystère 20	Capt. Michael Ron	entered a spin during 2v2 ACM training, pilot killed
20 Feb 61	S. Mystère 32	Sub-Lt Zvi Umshweif	bird strike, pilot ejected successfully
10 Mar 63	S. Mystère 27	-	burnt-out on the ground
23 Oct 63	S. Mystère 63	Lt Uri Shachar	pilot experienced severe vibrations; ejected successfully
20 Nov 63	S. Mystère 62	Lt Col Israel Lahav	engine cut, pilot ejected too low and was killed
30 Dec 65	S. Mystère 38	Capt. Iftach Spector	engine exploded, pilot ejected successfully
12 Jan 66	S. Mystère 24	Lt Shamuel Gordon	engine fire, pilot ejected successfully
3 Mar 66	S. Mystère 14	Lt Shimon Lavi	cockpit filled with smoke, pilot ejected
22 Aug 66	S. Mystère 16	Capt. Betsalel Ofer	aircraft caught fire, pilot ejected successfully
18 Oct 66	S. Mystère 26	Capt. Shlomo Shapira	damaged by ricochet, pilot ejected successfully
5 Jun 67	S. Mystère	Capt. Alexander Armon	shot down in air combat with EAF MiG-21s; pilot killed
5 Jun 67	S. Mystère	Lt Amiram Manor	shot down in air combat with EAF MiG-21s, pilot ejected, but was murdered by local Bedouins
5 Jun 67	S. Mystère	Capt. Dan Engel	shot down by AA fire over Inchas; pilot killed
5 Jun 67	S. Mystère	Capt. (res) Dan Sigri	shot down by AA fire over Dmeir; pilot ejected, but was murdered on the ground
6 Jun 67	S. Mystère	Lt Eli Zohar	shot down by SA-2 over Sinai, pilot ejected over friendly troops
6 Jun 67	S. Mystère	Lt Yair Barak	shot down by AA fire over Sinai, pilot ejected and taken PoW
7 Jun 67	S. Mystère	Lt Igal Shochat	shot down in air combat with EAF MiG-17s, pilot ejected over friendly troops
9 Jun 67	S. Mystère 32	Lt Col Shlomo Bet-On	shot down by AA fire over the Golan Heights; pilot killed
10 Jun 67	S. Mystère	Capt. Ben-Zion Gaifman	shot down by AA fire over the Golan Heights; pilot killed
1968	S. Mystère 24	?	engine fire during night sortie; pilot ejected successfully
4 Dec 68	S. Mystère	Lt Nadav Nehorai	shot down by AA fire over Jordan, pilot ejected but was murdered on the ground
31 Jul 70	S. Mystère	?	engine cut at night, pilot ejected successfully.
1 Sep 72	Sa'ar	Capt. Yehuda Tamir	pilot killed
7 Oct 73	Sa'ar 18	Lt Aviram Cohen	take-off accident, aircraft written-off; pilot seriously injured
7 Oct 73	Sa'ar	Capt. Doron Smadar	shot down by SAM over the Golan Heights; pilot killed
7 Oct 73	Sa'ar	Capt. Itshak Kaidar	shot down by SAM over Kantara; pilot killed
7 Oct 73	Sa'ar	Lt Eli Gor	PoW in Egypt
11 Oct 73	Sa'ar	Lt Lipsich	shot down by AA fire over Tel-Shams, pilot ejected
17 Oct 73	Sa'ar	Capt. Tamir	shot down by SA-6, pilot ejected
74	Sa'ar	Capt. Amiram Shaked	pilot ejected

The Brakeet, the IDF/AF's F-16 SEAD variant, has equipped No. 105 Sqn since the early 1990s. Views of these aircraft in squadron service are rare. Those that have emerged have featured this aircraft, 628. Finished in standard IDF/AF camouflage, the aircraft has gained a scorpion fin marking and double arrowhead on its drag 'chute fairing. Seen here in a shelter at an unknown airfield, 628 carries an AIM-9 AAM, an LGB and fuel tank.

Grumman's Avenger is something of a paradox: it was the largest single-engined aircraft to serve in World War II but flew from the smallest aircraft-carriers; designed to attack with torpedoes, it dropped far more bombs than it launched 'tinfish'; never intended to dogfight with enemy fighters, it gave better than it got in aerial combat. Even today, nearly 60 years after its debut, a few 'Turkeys' ('the biggest bird in the yard') are still in service, but fighting fires and preventing destruction rather than causing it. There can be no better testament to the durability of the products of the 'Iron Works'.

Grumman TBF/TBM Avenger



A flight of TBFs makes a textbook torpedo attack with box-tailed Mk 13 weapons, spring 1942. The Mk XIII was better than the submarine or ship-launched Mk XIV, but not much, and seriously hampered the employment of the Avenger as a torpedo bomber as it could not be dropped at a speed higher than 100 mph (63 km/h), or at a height above 120 ft (37 m). The development of the ring-tailed Mk XIII Mod 2 allowed drops from up to 800 ft (244 m) and as fast as 300 mph (483 km/h).

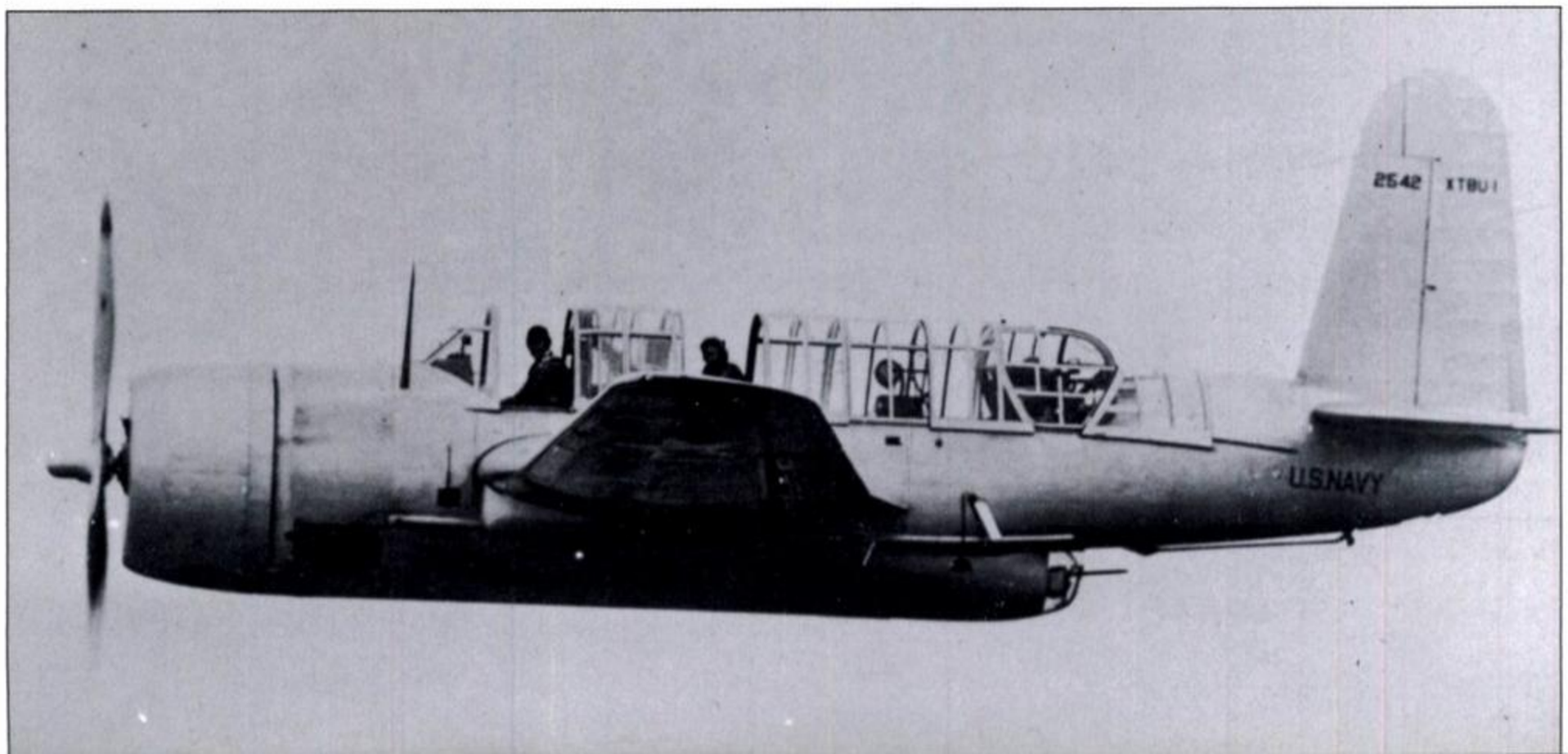
On 31 March 1930 Captain Rufus Zogbaum, USN, described a recent fleet exercise to his friend, Captain Ernest J. King, USN, saying, "You know the Scouting Fleet put it all over the Battle Fleet. The *Lexington* ... catching the *Saratoga* [and] *Langley* with all aircraft on deck, giving us a chance with torpedo aircraft ... to finish the fight almost before the two fleets got together." Similar letters describing tactics could have been written by officers in many of the world's naval powers in the years after World War I. The concept of attacking surface ships with air-dropped torpedoes entered naval thinking less than a decade after an aircraft first made a powered flight over the windswept dunes of coastal North Carolina. During World War I both German and British pilots sent ships to the bottom with torpedoes, transforming theory into practice.

The United States Navy conducted its first test launch of torpedoes from an aircraft in August 1917 without success, prompting some senior officers to question whether flying machines were capable of carrying a torpedo of the weight necessary to sink a ship. The inevitable development of aircraft made this point irrelevant and allowed a concerted effort on the part of the Navy to develop the torpedo-bombing mission. A host of aircraft, both on wheels and floats, filled torpedo squadrons throughout the 1920s and early 1930s, until the introduction of the TBD Devastator in 1937. An all-metal monoplane, this carrier-based aircraft outclassed its biplane predecessors and became a mainstay in the fleet, yet, by 1939, the march of technology had brought the Devastator itself to the brink of obsolescence. In a mission that involved hugging the waves on a predictable attack course, the TBD's speed and limited defensive armament left much to be desired.

As a result, the Bureau of Aeronautics (BuAer) issued a call for design proposals for a new carrier-based torpedo-bomber that could fulfil a multitude of missions, including bombing and torpedo attack, scouting, strafing and smoke laying. The capabilities of the chosen aircraft would contrast sharply with those of the TBD it was designed to replace: maximum speed of 300 mph (482 km/h) vs 206 mph (331 km/h); maximum range of more than 1,000 miles (1609 km) vs one of 716 miles (1152 km); service ceiling of 30,000 ft (9144 m) vs 19,700 ft (6004 m). Other design parameters included a maximum carrier take-off distance of 325 ft (99 m) with wind across the bow, and an internal weapons bay, a first for a carrier-based aircraft. Six different manufacturers responded to the Navy's request with 13 different designs, the most promising coming from two companies with a tradition of producing aircraft for the Navy. On 8 April 1940, Grumman received a contract for two prototypes, and two weeks later the Navy awarded a similar one to Vought.

The boys from Bethpage

Incorporated on 6 December 1929, the Grumman Aircraft Engineering Corporation was destined to make aircraft for the Navy given the fact that its founder, Leroy Randle Grumman, himself served as a naval aviator during World War I. From its inception, the staple of the company's production had been fighters and amphibians, so the contract for a torpedo-bomber prototype represented a jump into unfamiliar territory. In its favour, Grumman had a proven track record as a ground-breaker. Delivered to the fleet in 1933, the company's FF had been the first carrier-borne aircraft to incorporate retractable landing gear, and its J2F Duck was the Navy's choice to outfit its first utility



The main rival for the torpedo-bomber requirement was the Vought TBU Seawolf. Several features shared with the Avenger can be seen in this view of the first XTBU-1, including the ventral 'tunnel' gun and elongated 'glasshouse' with a single-gun turret. Ordered two weeks after the XTBF-1s and flown on 22 December 1941, the Seawolf was mostly inferior to the Avenger. The type entered production with Consolidated-Vultee in 1943 as the TBY-2, but the 180 built never became operational.

The first XTBF 1 (BuNo. 2539) is seen in flight over Long Island in the latter half of 1941, having flown for the first time on 7 August of that year. A number of changes were made to the aircraft in its brief career, most notably the addition of a dorsal fin at the base of the tail. Another change was the relocation of the engine mount to a more forward position.

squadrons. Within three months, Grumman produced the mock-up for the XTBF-1 (X for experimental, TB for torpedo-bomber, and F for Grumman); based upon what it saw, as well as the pressing need for torpedo aircraft, the Navy took an unprecedented step of ordering 285 examples of the new aircraft. The date was 30 December 1940, and there were still seven months before the first XTBF-1 would even be ready to take to the air.

The resulting prototype seemed to justify the Navy's confidence. Possessing Grumman's trademark barrel-like fuselage, the XTBF-1 had a certain degree of ruggedness, heightened by the fact that the aircraft stood 16 ft (4.8 m) tall. Like the company's recently introduced F4F-3 Wildcat fighter, the XTBF-1 featured the so-called 'sto-wing', in which the wings folded backwards along the sides of the fuselage, a definite space-saver on a crowded carrier hangar deck. The concept was the new brainchild of Roy Grumman, who visualised it with the use of an eraser and two paper clips. Per BuAer specifications, the XTBF-1 featured an internal weapons bay capable of housing one Mk XIII torpedo or four 500-lb bombs. Compared to the TBD, the Grumman aircraft bristled with armament. A 0.30-in machine-gun on the starboard side of the cowling provided the pilot with some offensive capability if he came under attack, while a ventral 0.30-in gun offered protection below and aft The third machine-gun station represented a Navy first. Located forward of the tail, a 0.50-in machine-gun protruded from an electrically-driven ball turret, a joint Grumman/General Electric venture which was the first ever installed on a naval aircraft. Designed to rotate 360°, it allowed gunners to fire from a range of 85° above horizontal and 30° below horizontal. At top speed, the turret's 0.50-in M2 machine-gun could turn at 30° per second and elevate at 45° per second. With the gun offset to the gunner's left, the visibility was excellent when the turret was in operation.

Hydraulic operation

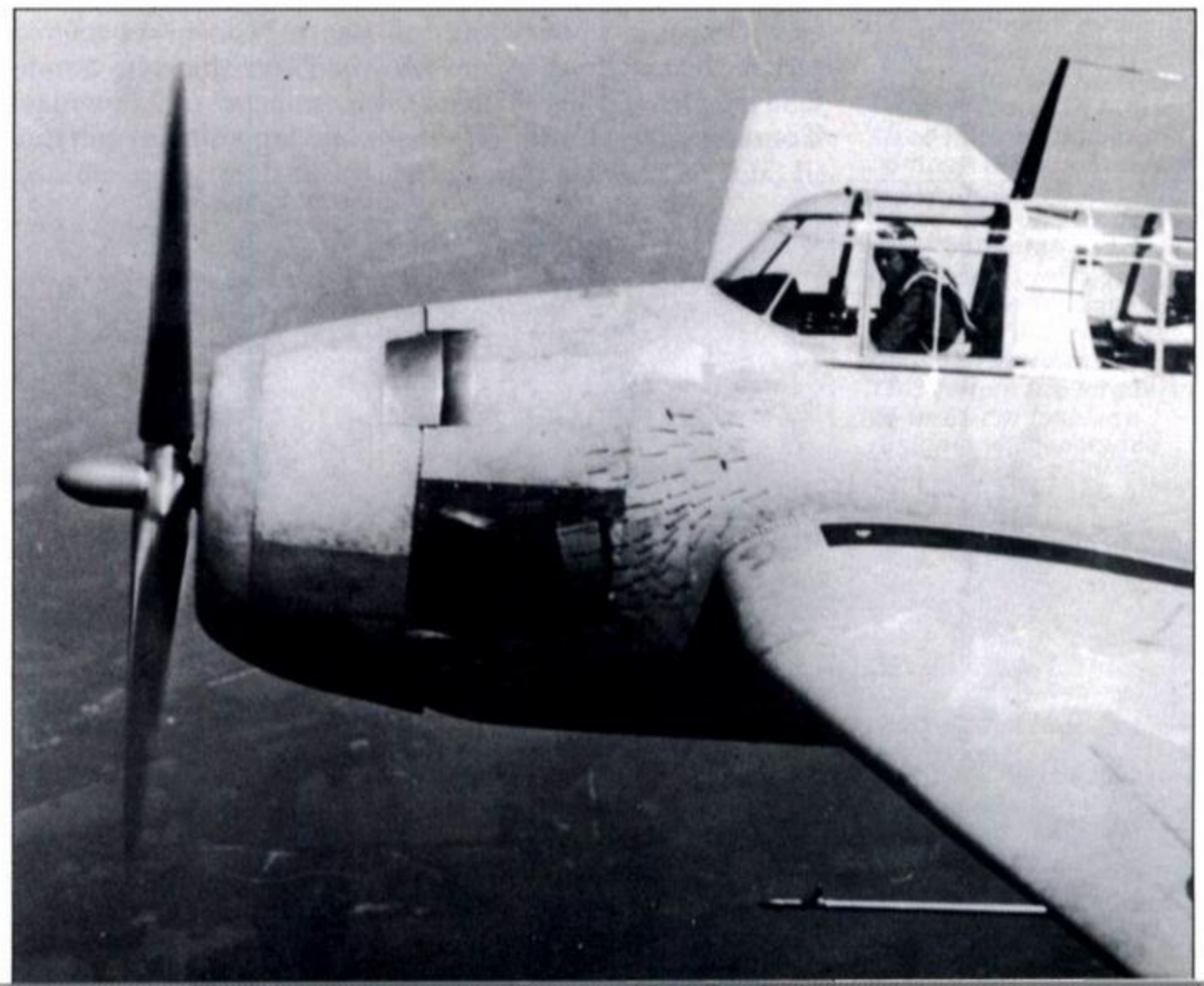
This represented but one first on the XTBF-1. A hydraulic system operated everything from flaps to landing gear to bomb bay doors, which was new to Grumman aircraft; it would also be one of the aircraft's recurring problems. During the war, company field service representative Ralph Clark reached the point where he received envelopes full of hydraulic seals from Grumman, which he carried around in his car to constantly give to torpedo squadrons, helping keep more machines in the air.

A true test of an aircraft comes not on the ground, but in the air. For the XTBF-1, 7 August 1941 marked the beginning of flight testing with Bob Hall, Grumman's chief experimental test pilot, at the controls. For Hall, a veteran of the company's JRF Goose and F4F Wildcat programmes, what looked like a winner on the ground proved to be a major disappointment. Performing his standard procedure of getting airborne for 10 seconds to ensure that the aircraft's centre of gravity was correct, Hall found himself shoving the stick full forward for a landing. After the ground crew removed several hundred pounds from the area around the turret (the weight simulated this yet-to-be-completed element of the aircraft), Hall tried again the next day with the same results. On 9 August the XTBF-1 finally stayed airborne, revealing a new batch of problems. The oil cooling system for the Wright R-2600 engine proved insufficient and, when Hall applied full rudder, the aircraft demonstrated a distinct lack of directional stability. As he related later to fellow test pilot Corwin 'Corky' Meyer, those three days in August brought the most technically embarrassing flights of his career.

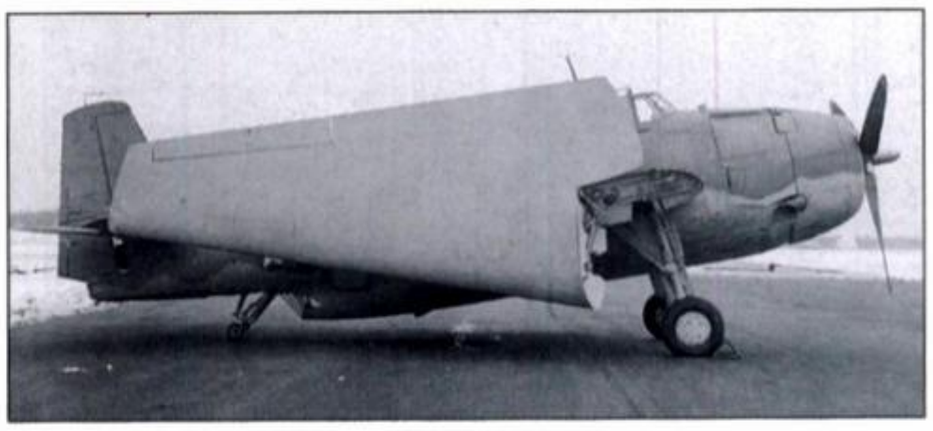
Going back to the drawing board, Grumman engineers corrected the stability problem by fitting a large dorsal fin forward of the tail and increasing the size of the fin and rudder. In addition to installing a larger oil cooler, they also extended the engine mount by 11 in (28 cm) to offset the weight of the ball turret. During the course of the next three months, Hall put the redesigned aircraft through its paces, logging 23 flights encompassing 23 hours. The aircraft was then turned over to another test pilot, Hobert 'Bill' Cook, and flight engineer Gordon Israel for the final stage of testing.

Again, disaster struck. On 28 November the pilot reported a fire in the bomb bay during a full-power climb over Long Island. Both crewmen managed to bail out of the stricken craft before it plummeted to the ground. Investigations at the crash site revealed no sign of fire, and Israel reportedly later told employees on the ground that he heard a loud thump and thought it was a problem with the torpedo they were carrying. Whatever the cause, for the men of Grumman's Plant 1, who worked overtime to complete all

In this view of the first XTBF-1, wool tufts can be seen on the forward fuselage during a test flight. The tufts followed the surface airflow and were part of testing to solve a cooling problem and reduce drag on the aircraft. The pilot here is Hobart Cook, who, along with flight test observer Gordon Israel, was forced to bail out of this aircraft on 28 November following an inflight fire. The aircraft crashed near Brentwood, Long Island.



These three views show XTBF-1 No. 2 at Bethpage in the winter of 1941/42. Few differences can be seen compared to most production TBF-1s, other than the arrangement of windows around the rear compartment. The small fuselage insignia and the lack of insignia on the starboard upper/port lower wings was the specification in force until January 1942. The patented Grumman wing-folding system reduced the stowed width from 54 ft 2 in (16.51 m) to 18 ft 4 in (5.59 m), another important advantage over the TBY Seawolf. Total cost of the two XTBF prototypes, drawings and ground testing was contracted at $556,000.



XTBF-1

The first two Avengers rolled out of Plant 2 at Bethpage were little different externally from the 9,839 that followed. Aircraft number two (BuNo. 2540) was well advanced by the time of the first aircraft's loss and was ready to fly before the end of the year. It was the aircraft the workers' families saw when they visited the factory's open day on 7 December, the day of the Japanese attack on Pearl Harbor. Within a year, the plant was building 100 Avengers per month.

of the work on Bureau Number (BuNo.) 2539, the crash was a disappointment. Luckily, what could have been a set-back in production was saved by the fact that the Navy had ordered two XTBF-1 prototypes. BuNo. 2540, having been fitted with the changes prompted by the test flights of its sister aircraft, made its maiden flight just three weeks after the crash.

Eleven days later, on 30 December 1941, one year to the day of the Navy's contract for the aircraft, the first production TBF-1 took to the sky near Bethpage. By this time the United States was at war, making the need for the aircraft even greater. Although in its final form the TBF-1 did not meet contract requirements in speed and service ceiling (275 mph; 443 km/h and 22,000 ft/6706 m), it was further along than Vought's competing TBU – which was taking a back seat to development of the F4U Corsair fighter – and was a vast improvement over the TBD. And there was no doubt about what the Navy expected of its new acquisition when, responding to the decision to name aircraft for simpler identification, the service bestowed upon it the name Avenger. Back at Bethpage, the employees of the new Plant 2, which would turn out the TBF, felt the name was fitting. Ironically, an open house for employees to show off the complex to their families had occurred on 7 December 1941.

First blood

It fell to a new squadron to introduce the TBF-1 to the fleet. Established in the previous summer, VT-8 (V for heavier-than-air aircraft and T for torpedo-bomber) was part of the air group assigned to the Navy's newest carrier, USS *Hornet* (CV-8). Under the command of Lieutenant Commander John C. Waldron, the squadron operated TBDs on the ship's shakedown cruise during January 1942, but in March began receiving its first Avengers. Their arrival created a dilemma, for the time was simply not available to indoctrinate pilots and aircrew in the new aircraft before *Hornet* went to sea. The resulting solution was a split in the squadron, with Waldron taking the experienced core of the squadron to the Pacific with TBDs, leaving behind executive officer Lieutenant Commander Harold 'Swede' Larsen to fill the TBF-1s primarily with incoming replacement pilots.

Among those in Larsen's TBF Receiving Detail was a 17-year-old radioman named Harry Ferrier, a Massachusetts native who had lied about his age to enlist in the Navy. Drawn to torpedo aircraft by an article he had seen in *Life* magazine, he reported to VT-8 in autumn 1941. To the contrary, replacement pilot Ensign Bert Earnest lamented his assignment to torpedo aircraft, whose low and slow mode of attack did not seem "like a recipe for long life." Having flown the Devastator, however, he realised that the Avenger bettered his odds. "We flew the aircraft as much as we could," he recalled of VT-8's stateside training, "and we were impressed with the performance and load-carrying capabilities compared to the TBD." As part of this training, Earnest had the opportunity to make a few torpedo drops in the waters off NAS Quonset Point, Rhode Island, in May 1942, where he was pleased to discover that he could make a drop at 125 kt (144 mph; 231 km/h), compared to 80 kt (92 mph; 148 km/h) in the TBD. It was while engaged in this training that word came to make ready to deploy. Trouble was brewing in the Pacific.

Following a cross-country flight and overwater transport to Hawaii aboard USS *Hammondsport* (AVP-2), VT-8's 20 TBF-1s and their crews arrived at Pearl Harbor on 28 May, only to discover that *Hornet* had put to sea the previous day. A decision was made to send six aircraft to Midway Island, about 1,200 miles (1931 km) to the west, to bolster the defences there. Selected to lead the flight was Lieutenant Langdon H. Fieberling, and among the volunteers chosen to go were Ensign Bert Earnest and RM3c (Radioman 3rd class) Harry Ferrier, who made up a crew along with Sea1c (Seaman 1st class) Jay D. Manning. The detachment departed Ford Island early on the morning of 1 June, with Earnest flying BuNo. 00380, Larsen's assigned aircraft. It was the first time he had flown out of sight of land.

The TBFs had been brought to Midway by a planned

Local residents and Grumman workers assist in righting an early TBF-1 that had made a forced landing in a field near Bethpage, New York in early 1942. Little damage appears to have been caused in the incident. Note what appear to be temporary de-icer bags on the wing leading edges and the platform for the combat camera forward of the windscreen.

Japanese attack against the island, with a diversionary strike against the Aleutians. The goal of the attack was to draw the remaining American aircraft-carriers into a decisive fleet battle that had long been a major element of Japanese strategy. However, the Imperial Japanese Navy did not count on the US Navy reading its mail. Working in an underground bunker below the headquarters of ADM, Chester W. Nimitz, Commander-in-Chief of the US Pacific Fleet, Lieutenant Commander Joe Rochefort and a talented group of cryptanalysts had broken the Japanese naval code. Armed with knowledge of where the enemy was going to strike, Nimitz positioned his carriers north-west of Midway in a position to attack the flank of the Japanese ships approaching the island. In addition, he transformed Midway itself into an unsinkable carrier. When the six VT-8 TBF-1s arrived, they joined Marine F2A Buffalo and F4F fighters, SBD Dauntless and SB2U Vindicator dive-bombers, PBY Catalina patrol aircraft, and Army Air Forces B-26 and B-17 bombers.

In the early morning of 4 June, the waiting ended when Midway-based Catalinas spotted the approaching Japanese carriers and an inbound strike from the enemy aircraft-carriers. Midway suddenly became a beehive of activity. Shortly after 06.00, Fieberling's six TBF-1s roared into the morning sky, climbing to an altitude of 4,000 ft (1219 m) and heading northwest at a speed of 160 kt (184 mph; 296 km/h). Sitting in the bowels of 8-T-1, RM3c Harry Ferrier was confident of Earnest's ability as an airman; he had respectfully declined Fieberling's offer that he fly with the lead aircraft of the second section. The next few hours would justify his confidence and decision making.

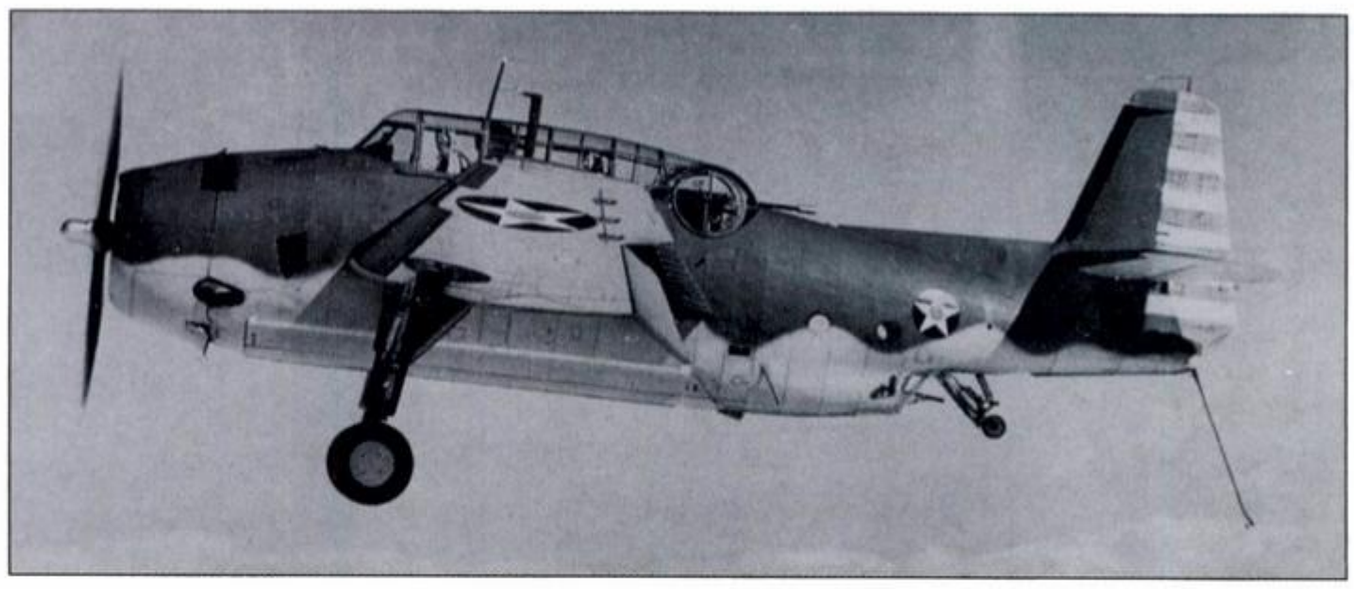
Action at Midway

No sooner had the VT-8 aircraft begun their flight than three Japanese aircraft, part of the strike group launched from four Japanese carriers west of Midway, made a pass at the formation. No Avengers were hit, and for the next hour things were relatively calm. Around 07.00 Fieberling spotted elements of the Japanese fleet at a distance of about 15 miles (24 km) and organised his formation for an attack. The first Midway-based aircraft to spot the Japanese fleet, they drew the attention of a flock of orbiting A6M2 Zero fighters, which quickly pounced on the TBFs as they descended to 150 ft (45 m) for their torpedo runs.

Earnest remembered that there were so many fighters "they seemed to be getting in each other's way." In the radio compartment, Ferrier could hear Manning rattling away in the turret and the metallic pings of Japanese fire hitting the aircraft. "Then the turret quit firing and I looked over my shoulder ... and I could see that Jim Manning had been hit ... it was pretty much a bloody mess." With Manning killed, Ferrier's 0.30-in gun became an even more important part of the aircraft's defences; however, one round hit him in the left wrist and another knocked out the aircraft's hydraulic system, causing the tail-wheel to drop down in front of gun, rendering it useless. Although smarting from his wound, the young radioman managed to peek from the radio compartment's small window, from which he could see only a burning aircraft. It was the last thing he saw for a while, for at that moment yet another round grazed his scalp, knocking him unconscious.

Meanwhile, Earnest was having his own troubles. Japanese bullets repeatedly slammed into the armour plating of his seat and peppered the wings of the Avenger. A flying piece of shrapnel struck him in the neck, covering the cockpit with blood. With his intended target, a carrier, still a good distance away, Earnest also lost elevator control. Certain that his aircraft was going to end up in the water, he yanked 8-T-1 around to port and dropped his torpedo against what he thought was an escorting light cruiser. Fortune was on the young ensign's side that day, for he soon discovered that he could control the TBF-1 using the elevator tab. Flying in this manner, he managed to survive additional attacks by Japanese fighters and reach relative safety. His was the only surviving aircraft of the six.

BuNo. 00380 was riddled with holes, had an inoperable compass and no hydraulics, the latter malady preventing Earnest from closing his bomb bay doors and lowering his flaps. However, the rugged Grumman machine still flew, and Earnest headed south to avoid flying over the Japanese fleet, planning to eventually turn east towards Midway using the sun for navigation. Sometime during the return trip, Ferrier awakened. "The next thing I remember was coming to with my head hanging down and all I could see was blood pouring off my head. And I put my hand up there and at that time it almost felt like I could stick my finger in a hole." When he heard of Manning's death over the intercom, Ferrier climbed into the seat located just behind Earnest. After turning east, the pair noticed a huge cloud of black smoke in the distance. It was Midway. Although he could manage to get down only one wheel, and that by using the emergency release lever, Earnest made an approach for landing. Ignoring a third wave-off, he



Photographed on 23 March 1942, the first production TBF-1, BuNo. 00373, lets it all hang out. Notable is the tailhook, which on all Avengers before TBM-3E BuNo. 86175 extended from an internal sleeve. The low Bureau Numbers of early Avengers reflect the introduction of the new number series in 1940. The last TBM-3, delivered in September 1945, was 91752, reflecting the gigantic number of aircraft built to USN contracts during the war. In 1998, new numbers are being issued in the 165000 series.

This Grumman publicity shot reveals an early TBF-1, straight from the factory. Note the larger-sized national insignia compared to that on the first production aircraft above. If regulations were being followed, and there is no reason to believe otherwise, this photo dates from between early January 1942 (when the larger 24-in/61-cm fuselage insignia was specified and insignia was reinstated on all four wing surfaces) and mid-May 1942 (when the red centre to the insignia and the rudder stripes were ordered discontinued). The blue-grey over light grey camouflage dated from October 1941 and was painted on new aircraft until February 1943.

This photograph depicts two of the first Avengers to enter squadron service. The submarine periscope seen behind the tail of T-43 was crudely deleted from some copies of the original print.

touched down in his crippled aircraft, which spun to a stop along the edge of the runway. The Avenger's first combat mission was over.

Much has been written about the loss of the carrier-based torpedo squadrons at Midway, which fought against the odds in inferior aircraft with no fighter cover. The flight of VT-8's TBF detachment was no less tragic. Flying a new, untried aircraft, six relatively inexperienced crews faced off against nearly 30 Japanese fighters. Only two of 18 men survived. It was a less than glowing beginning for the TBF Avenger, but the chance to redeem itself was not far in the future.

Having struck a blow against the Japanese fleet at Midway, the US Navy turned on the offensive. The target was Guadalcanal, an island near the bottom of the Solomons chain on which the Japanese were constructing an airfield. Planners set the invasion, codenamed Operation Watchtower, for 7 August 1942. The Navy's victory at Midway had certainly been a turning of the tide, but Guadalcanal marked the watershed battle of the Pacific war, featuring savage struggles amid the steamy jungle landscape, landmark sea battles, and epic aerial engagements. For six months the opposing sides hammered away at one another, the Americans maintaining an uncertain foothold in their first offensive of the war and the Japanese desperately fighting to turn them back. During the course of the battle, control of the waters surrounding Guadalcanal and the air above it was pivotal, for the side with the advantage could prevent reinforcements and supplies from reaching the ground forces. This meant plenty of action for naval aviation, including its new front-line torpedo-bomber.

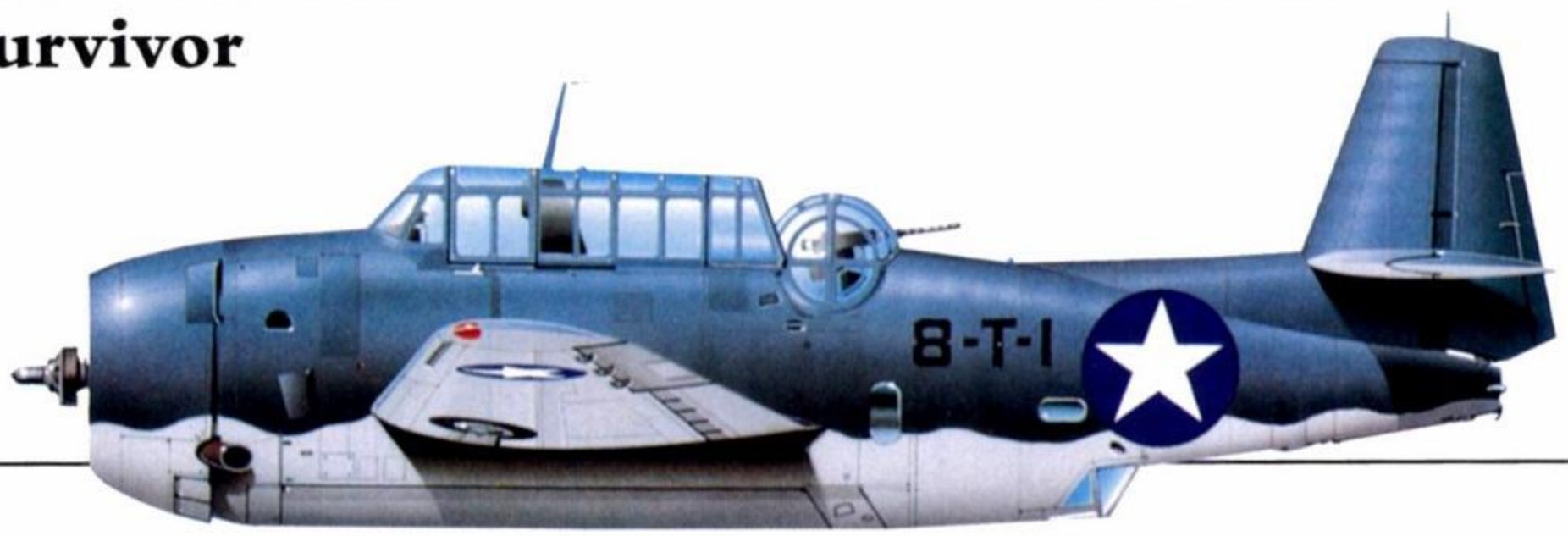
Avengers during Watchtower

By the time of the invasion five Avenger squadrons were either forming or in operation. Among them were those participating in Watchtower – VT-7 in USS *Wasp* (CV-7), VT-8 in USS *Saratoga* (CV-3), and VT-3 in USS *Enterprise* (CV-6). For them, the first opportunity to strike a blow against the Japanese at sea came on 24 August 1942, during the Battle of the Eastern Solomons, an engagement pitting *Saratoga*, *Enterprise* and their escorts (Task Force 61) against a force that included three Japanese flat-tops. The first Avengers to enter the fray were seven VT-3 TBF-1s launched from the 'Big E' at 13.15 to scout an area where PBY patrol aircraft had previously reported a Japanese task force that included one carrier. Squadron skipper Lieutenant Commander Charles M. Jett and Ensign Robert J. Bye were the first to spot the enemy ships, and they immediately climbed to altitude for a horizontal bombing run out of the sun against the force. Their quarry was the light carrier *Ryujo*, but its captain's sharp turn to starboard caused the TBF-1's four 500-lb bombs to splash harmlessly in its wake. This attack alerted *Ryujo*'s combat air patrol, which sliced into two other Avengers that arrived on the scene just after Jett and Bye. Two Zeros broke up their attack, chasing Lieutenant John Myers away and splashing the TBF-1 flown by Machinist Harry Corl, one of the few surviving TBD pilots from the Battle of Midway. Myers would not get off scot-free. Returning to *Enterprise* while it was under attack by aircraft from the two other Japanese carriers, his TBF-1 was peppered with between 50 and 100 holes by a single Zero, which left both his crewmen wounded. True to its origins, the tough Grumman held together and brought them safely home.

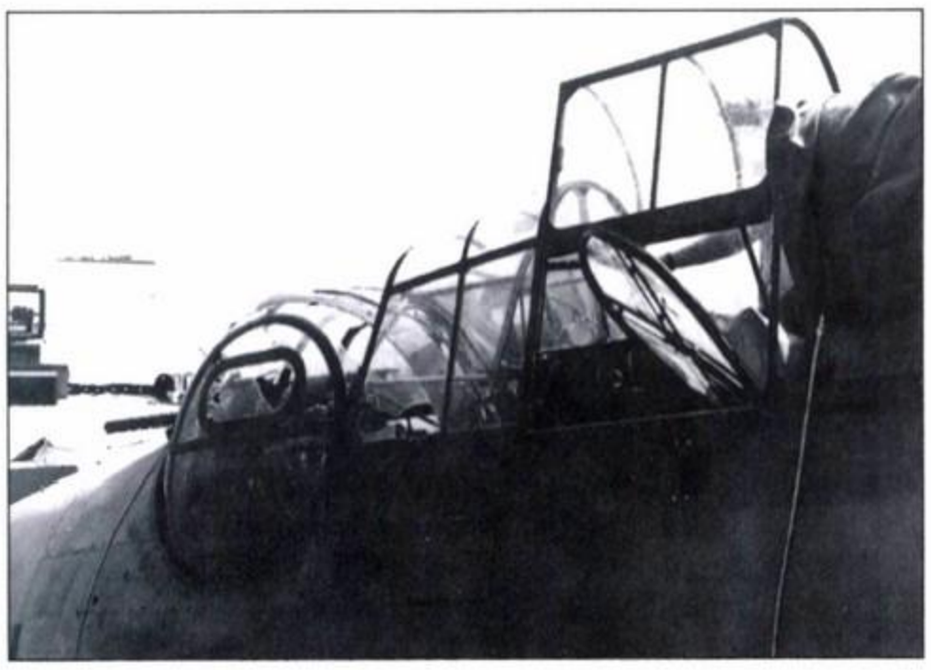
At the same time the VT-3 search aircraft were engaging the enemy, their brethren in VT-8 winged their way towards *Ryujo* as part of a 36-strong strike group of Dauntlesses and Avengers from *Saratoga*. Under the command of Lieutenant Bruce L. Harwood, these seven TBF-1s carried Mk XIII torpedoes. Launching at 14.30, the strike group sighted the *Ryujo* force just over an hour later. While the dive-bombers screamed down from above, Harwood positioned five of his Avengers for an attack against the carrier, but smoke shrouding the target

Midway survivor

Ensign Earnest's TBF-1 (BuNo. 00380) of VT-8 (Detached) was finished in the standard 1942 colour scheme. The fuselage code designated aircraft '1' of Torpedo Squadron Eight.



Above, below and right: Three views illustrate Ensign A. K. 'Bert' Earnest's TBF-1 after its return to Midway Island. Damage to the hydraulics allowed only a partial extension of the landing gear, resulting in a crash-landing, as seen above. The turret in which Earnest's gunner AMM3c Jay D. Manning was killed can be seen below. The jettisonable turret side hatch has been placed in the rear cockpit. At right, in one of the best known Avenger photographs, sailors are inspecting the aircraft, which has been lifted back onto its wheels.



Massacre at Midway

At the time Task Force 16 sailed to meet the Japanese carrier force heading for Midway Island, 'Torpedo Eight' was training a detachment to work up on the new Avenger. Too late to meet *Hornet* at Pearl Harbor, the TBF detachment flew directly to Midway. At 06.00, VT-8 (Detached) launched Avengers BuNos 00380, 383, 384, 391, 398 and 00399 on the first combat mission for the big Grumman. Without co-ordination with other elements, the Avengers were set upon by the Japanese CAP as they approached the target and five of the six TBFs were quickly shot down; only Ensign A. K. Earnest's aircraft returned, with over 70 bullet holes. Two hours later, VT-8's Devastators were wiped out, with only one man surviving.

Lieutenant (junior grade) E. L. Fayle, scoring hits in the Avenger's wing and gun turret. In the face of the attack, gunner ARM3c Edward Velasquez managed to smoke one of the fighters, whose pilot had himself shot down some of VT-8's Devastators at Midway. Fayle managed to ditch his aircraft at Nura Island near Guadalcanal. Another TBF-1, that of Ensign John Taurman, made it to San Cristobal. Both crews were rescued.

All told, the performance of the TBFs in the Eastern Solomons was a success, as the aircraft scored its first torpedo hit of the war, which helped force the scuttling of the carrier *Ryujo*. However, the second carrier battle off Guadalcanal went well for neither the US Navy nor the Avenger.

The Battle of Santa Cruz on 26-27 October 1942 resulted in the loss of the carrier *Hornet* and damage to *Enterprise*, the latter having been repaired from bomb hits in the Eastern Solomons. Hampered by poor radio communications, two strikes involving TBFs failed to even locate the enemy carriers (the Japanese had four). In addition, one squadron received a rude introduction to combat. Recently arrived in the Pacific aboard *Enterprise*, VT-10 made one torpedo attack. Eight TBF-1s launched from the 'Big E' on the morning of 26 October in a combined strike group of SBDs and F4Fs against a reported two enemy carriers. The aircraft were still forming up when Zeros from an incoming Japanese strike group ambushed them. Among the victims were two VT-10 Avengers shot down, and another pair so badly damaged that they had to make water landings in the vicinity of *Enterprise*.

Cactus Air Force

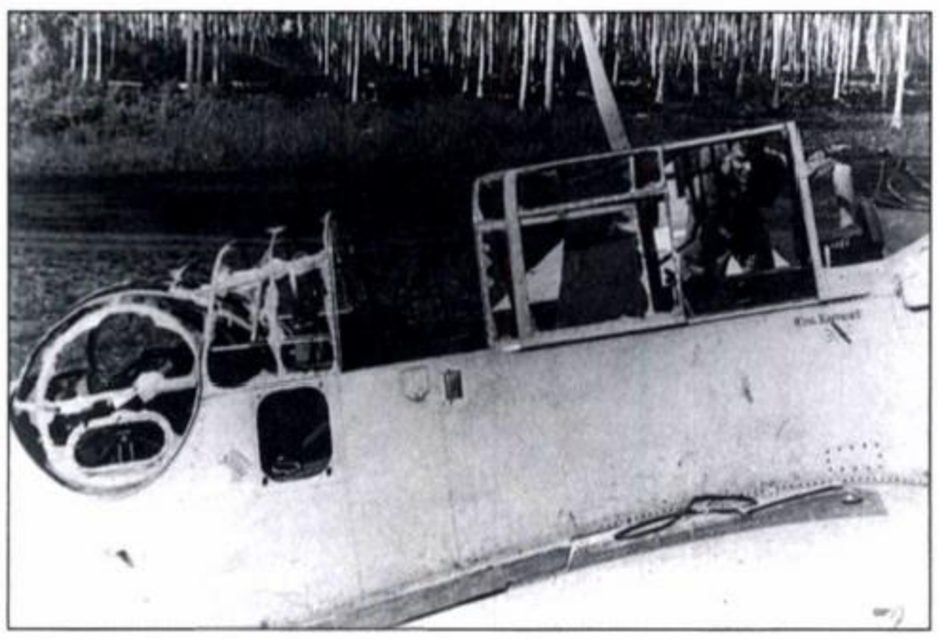
Not all Avengers flew from the decks of carriers. Displaced when *Saratoga* was torpedoed by a Japanese I-Boat and *Enterprise* received bomb damage in the Eastern Solomons, pilots from VT-8 and VT-3 found themselves assigned to the Cactus Air Force (Cactus was Guadalcanal's codename). Operating from Henderson Field, the Navy fliers lived a life that was a far cry from that aboard ship. In addition to the poor rations and ever-present battle against mosquitoes, there was the constant threat of enemy bombardment, be it in the form of air raids or salvos fired from surface ships coming down the 'Slot'. Bill Esders, a VT-3 pilot, remembered being handed a shovel

Lt (jg) Albert K. Earnest salutes after receiving the Navy Cross for his actions during the Battle of Midway. Between Midway and this ceremony on 24 February 1943, Earnest was involved in the Solomons campaign, torpedoed an enemy carrier and flew on another four torpedo attacks, all from land.

discouraged his effort on three separate occasions. Using high speed and jinking manoeuvres to evade anti-aircraft fire and attacking Zeros, Harwood's aircraft finally settled into a torpedo run with two aircraft boring in on the port bow and three attacking to starboard. At speeds of 200 kt (230 mph; 370 km/h) and an altitude of 200 ft (60 m), the five attackers launched their weapons at an average range of 800-900 yd (730-822 m). Only one torpedo hit home, but it was a crippling blow. Exacting revenge on behalf of Midway, Ensign Bert Earnest put his Mk XIII into the starboard aft portion of the ship, destroying *Ryujo*'s fire and engine rooms and knocking out its steering control. The other two TBF-1s attacked the heavy cruiser *Tone*, but scored no hits. All seven Avengers returned safely to *Saratoga*.

A second strike from *Saratoga*, consisting of five VT-8 TBF-1s under the command of squadron commander 'Swede' Larsen and a pair of VB-3 SBDs, discovered a force of four heavy cruisers, six light cruisers, and eight destroyers. Spying the force from an altitude of 7,000 ft (2133 m), the torpedo aircraft manoeuvred for an attack against the cruisers and destroyers while the SBDs went after the seaplane tender *Chitose*, which they spotted in the distance. Under constant anti-aircraft fire, the Avengers manoeuvred for an attack, briefly masking themselves in a cloudbank. Descending for an attack to port against the four heavy cruisers, which according to the squadron action report were "in line abreast at the initial attack and presented a beautiful target," Larsen's TBF-1s dropped their torpedoes at a range of 1,200 yd (1097 m). None struck the target. Unlike their squadron mates in the earlier strike against *Ryujo*, this attack group did not bring everyone home. A pair of Zeros jumped the aircraft flown by

*Flight deck crewmen aboard **USS** Enterprise (CV-6) gather around a TBF-1 of VT-6 that ended up in the port catwalk after a landing accident. Note the men climbing onto the starboard wing in an effort to weigh it down so that the stricken Avenger can be pulled onto the flight deck.* **Enterprise** *was en route to the Solomon Islands for the invasion of Guadalcanal when this photograph was taken on 23 July 1942.*



Above right: A Marine at Henderson Field on Guadalcanal examines the shattered cockpit of the TBF-1 Avenger flown by VT-8 pilot and Midway survivor Ensign 'Bert' Earnest during the battle for the island. Notice the symbol painted beneath the cockpit representing a hit scored against the Japanese carrier **Ryujo**.

A dozen TBF-1s from VT-10 fly in echelon, circa December 1942. This squadron lost a number of aircraft and crews in the Battle of Santa Cruz, 26-27 October 1942.

Guadalcanal

The Avenger was involved in the first American offensive of the war when aircraft from three carriers flew ground support and scouting missions during the invasion of the southern Solomons in early August 1942. The units involved were VT-3, VT-7 and VT-8 from *Enterprise, Wasp* and *Saratoga,* respectively. The units were effectively composites of the best crews and aircraft available at the time of departure, and VT-8 still numbered among its complement 'Bert' Earnest, sole pilot survivor of Midway. The Battle of the Eastern Solomons on 24-25 August resulted in the destruction of the carrier *Ryujo* by TBFs and SBD Dauntlesses. The cost was seven Avengers shot down, ditched or jettisoned due to battle damage. VT-8 and VT-10 were sent ashore to join the 'Cactus Air Force' on Henderson Field, Guadalcanal along with VMSB-131, the first USMC Avenger unit. These units finished off the battleship *Hiei*, again in conjunction with SBDs, and thwarted a daylight resupply mission on 14 November, helping ensure the survival of the Allied foothold on the much-contested island of Guadalcanal.

A weathered TBF-1 of VMSB-131, the Marine Corps' first Avenger squadron, is parked on the grass at 'Cactus' (Henderson Field) in December 1942.

Time *and* **Life** *magazine correspondent Howard Hunt (with binoculars) poses with three VT-11 pilots on Guadalcanal, May 1943: (l to r) LCdr F. L. Ashworth, LCdr Weldon Hamilton, and Lt (jg) George Gay. Gay was the sole survivor of VT-8's carrier-based TBD Devastators during the Battle of Midway, and Ashworth would later ride in* **Bock's Car** *when that B-29 dropped the second atomic bomb on Nagasaki.*

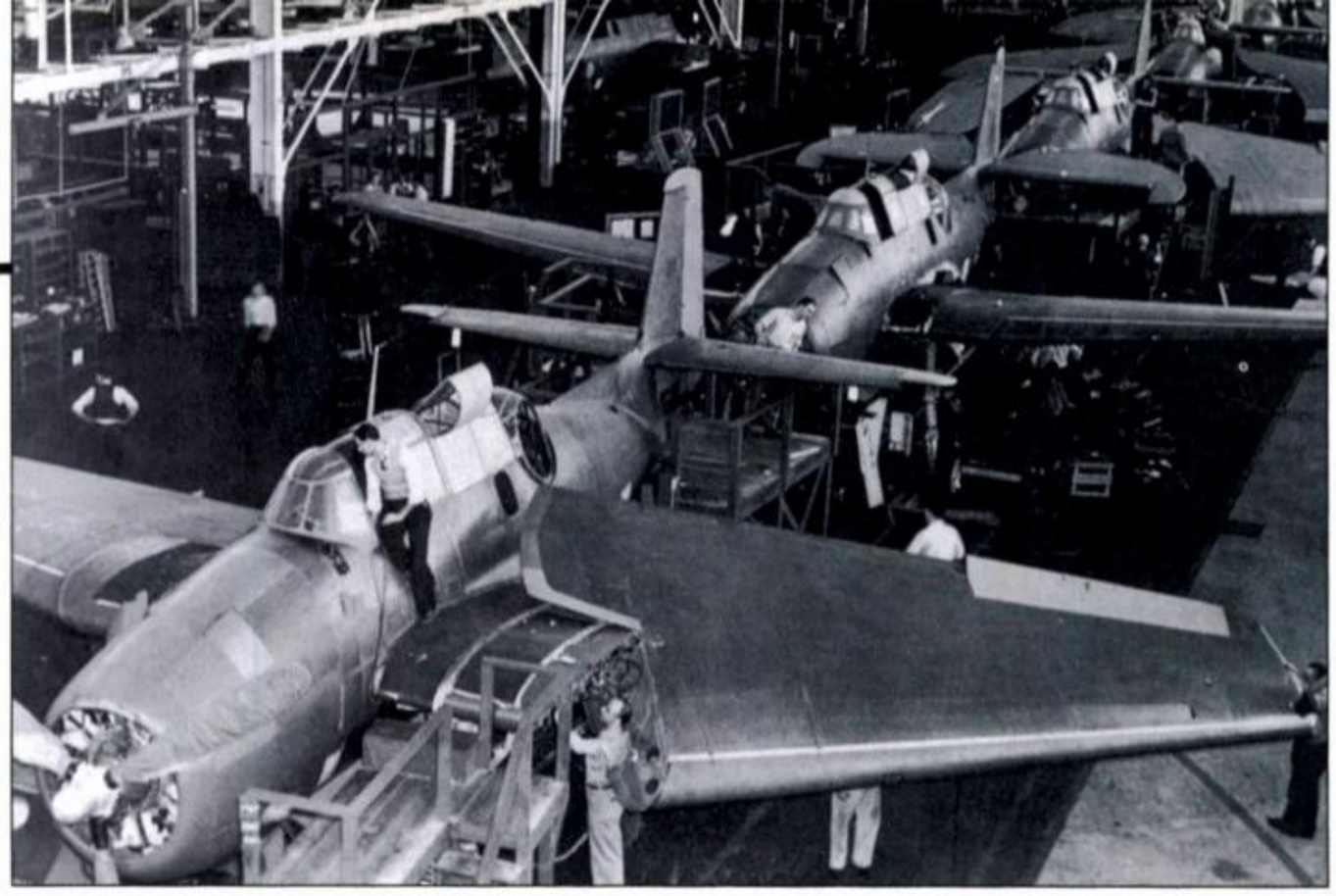
immediately upon his arrival at Henderson Field for the purposes of digging a foxhole next to his tent. He was also advised not to stop his aircraft at the end of the runway for a final check before take-off, lest a mortar round be lobbed in his direction. The hours spent digging proved fortuitous when, on 12 October, Japanese battleships staged a night bombardment. "Boy, we could hear those things singing going through the air," Esders recalled of the shells, which shook the ground and seemed to set the entire field afire. One round hit the base of a coconut tree scarcely 20 ft (6 m) from his foxhole, lifting it into the air.

When able to fly, TBFs flew a variety of missions. During his brief stay on Guadalcanal, Esders undertook close air support missions, in which flights of Avengers flew parallel to the front lines discharging their bombs in salvoes on enemy lines, and even participated in an abortive night attempt to attack Japanese shipping under the light of flares.

The primary mission of the Cactus Air Force was the

Built by GM

In order to concentrate on Hellcat production, Grumman made arrangements from early 1942 for the transfer of some, and then all, Avenger production to the Eastern Aircraft Division of General Motors. Despite early misgivings about entrusting aircraft production to an automobile manufacturer, the system worked well, and by September 1943, Eastern's Trenton plant (supplied with sub-assemblies by five other GM factories) was turning out more Avengers (designated TBMs) than the parent company could manufacture TBFs. In December 1943, Grumman built the last (of 2,291) TBFs. The peak month for Eastern was March 1945, with 400 aircraft completed. Following the Japanese surrender, production ground to a halt. In September 1945, the last 24 (of 7,546) GM-built Avengers were delivered.



Above: This view shows the Trenton, New Jersey plant where TBM final assembly took place. On the line are TBM-1Cs, 2,332 of which were produced, making it the second most numerous production model.

Left: A factory-fresh TBM-1 is run up by a General Motors production test pilot. This view gives a good impression of the shadow-shaded three-colour colour scheme introduced during 1942.

bombardment of Japanese ships attempting to reinforce the enemy garrison on Guadalcanal, the so-called 'Tokyo Express'. It was in this role that the Avenger scored its greatest success thus far in the war. On 12-15 November the Japanese attempted a major reinforcement effort consisting of 111 transports led by a bombardment force that included four battleships. The resulting Naval Battle of Guadalcanal included bitter night surface engagements that battered the Japanese ships and left them, as one squadron history recorded, "sitting like ducks on a millpond." Aircraft from three torpedo squadrons, including VMSB-131, the Marine Corps' first TBF squadron, pounded the helpless enemy force, planting torpedoes in the hull of the battleship *Hiei*, and sinking the transports *Canberra Maru* and *Nagara Maru*.

Attack on *Hiei*

George Bobb was a tunnel gunner for Captain George Dooley during VMSB-131's attacks on *Hiei* on 14 November. During the first attack against the giant battleship, he could see little during the torpedo run, but was greeted with a thrilling sight when Dooley made a steep banking turn to port and flew down the side of the ship. From his little window, Bobb could see Japanese sailors manning the rails, but the TBF was moving too fast for him to get a shot at them with his 0.30-in gun. A second attack against *Hiei* later in the day proved more exciting. "Dooley calls me up on the intercom and says he thought we hit the magazine. The whole front of the battleship was smoke and flame," Bobb recalled. However, it was not battle damage that they observed, but rather the battleship unleashing 14-in special incendiary shells. From his small window Bobb witnessed a disconcerting sight. "Here we have geysers coming up as high as we are." The battle signalled Japan's final thrust to retake the island, which the US declared secure in February 1943. Back in Bethpage, the Grumman company newspaper proudly proclaimed "Grumman blasted Japs off 'Canal."

By the end of the Guadalcanal campaign, naval aviators had formed some opinions about their new torpedo aircraft. One action report proclaimed the vast potential of the type for a wide variety of missions, which was exactly what the Bureau of Aeronautics had wanted when it contracted for the TBF. 'Swede' Larsen proclaimed its ruggedness in an interview after his return to the United States, saying, "The TBF ... is an excellent airplane. Without being dramatic, I don't think I'd be alive today if we had been given any other airplane to do the work we did."

However, there was room for improvement. The experience of tangling with Zeros, even though the Avengers gave as good as they got on most occasions, prompted a call for more defensive firepower, especially from pilots, who believed forward-firing 0.50-in machine-guns would

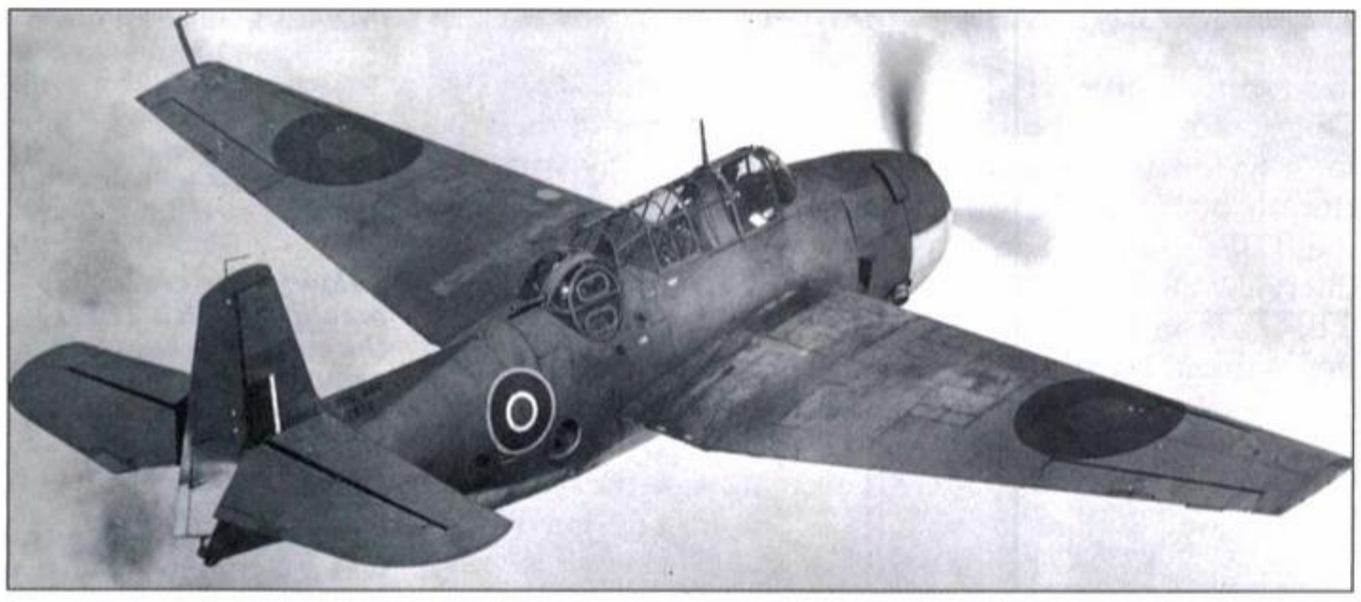
Below: A fire crew practises with a TBF-1 in the early-war two-colour camouflage scheme. The wing-fold configuration, whereby the wings rotated through 90° before laying flat alongside the fuselage, was a Grumman trademark.

Grumman Avenger

One of the first British Avengers was FN765, delivered to No. 845 Squadron at Quonset Point, Rhode Island in February 1943. Seen here at around this time, FN765 remained at Quonset with No. 738 Squadron, the FAA's American OTU and, in July 1943, moved with that unit to Lewiston, Maine where Avenger and other crews were trained until March 1945. The last record of this aircraft is when it was nosed over on 9 August 1943.

Tarpons for the FAA

Nearly 1,000 Avengers were accepted for use by the Royal Navy during the war. Boscombe Down received its first aircraft (FN767) for evaluation on 5 April 1943, some time after deliveries to FAA units working up in the USA had begun, such was the urgency of the need for a modern TR (Torpedo-Reconnaissance) aircraft for the fleet. Following the guidelines of the day, the FAA's TBFs were given the name Tarpon, after a type of game fish, but this name was dropped in January 1944. The aircraft were delivered from Grumman and Eastern factories to the British Modification Centre at NAF Roosevelt Field, New York, where Blackburn Aircraft modified US aircraft (principally Grummans) to meet British requirements. Some of the modifications made to British TBFs and TBMs included: fitting bulged transparencies to the rear compartment, hinging the aerial mast for increased headroom aboard ship, and fitting British radios.



JZ570, a TBM-1C (Avenger TR.Mk II) was bailed to 'C' Squadron of the A&AEE at Boscombe Down in July-September 1944 for performance tests, including evaluations with drop tanks. The tanks did not affect handling.

improve the aircraft's attack capability. Additionally, as Larsen pointed out, Avengers often attacked without escort, another reason for improved armament. After their experience in the Eastern Solomons, VT-3 pilots recommended equipping the Avenger with a belly fuel tank to increase its range for scouting missions. Another shortcoming that had less to do with the aircraft and more with the ordnance it carried was the unreliability of torpedoes. "I don't believe we're getting the efficiency out of our bombs that we should, and we're certainly not getting it out of our torpedoes," one pilot recalled. On numerous occasions, torpedoes failed to release, ran erratically, or simply bounced off the hull of the intended target. It would not be until 1944, when Cal Tech engineers fitted rings to the Mk XIII to allow for drops from higher speeds and altitude, that torpedo performance improved.

Glide bombing and Avenger developments

In addition to material matters, the Avenger's first sustained combat confirmed the effectiveness of glide bombing, a tactic with which VT-6 experimented in July 1942. Larsen believed it to be particularly effective in low cloud cover, and urged the Bureau of Aeronautics to further training in this type of attack. It would become a

Above and below: These Avenger Mk IIs operated at Boscombe Down. Between 1943 and 1945, various aircraft passed through for routine trials and clearance of British bombs and mines. One aircraft was fitted with a Fraser-Nash FN95 twin-gun turret designed for the Fairey Spearfish.

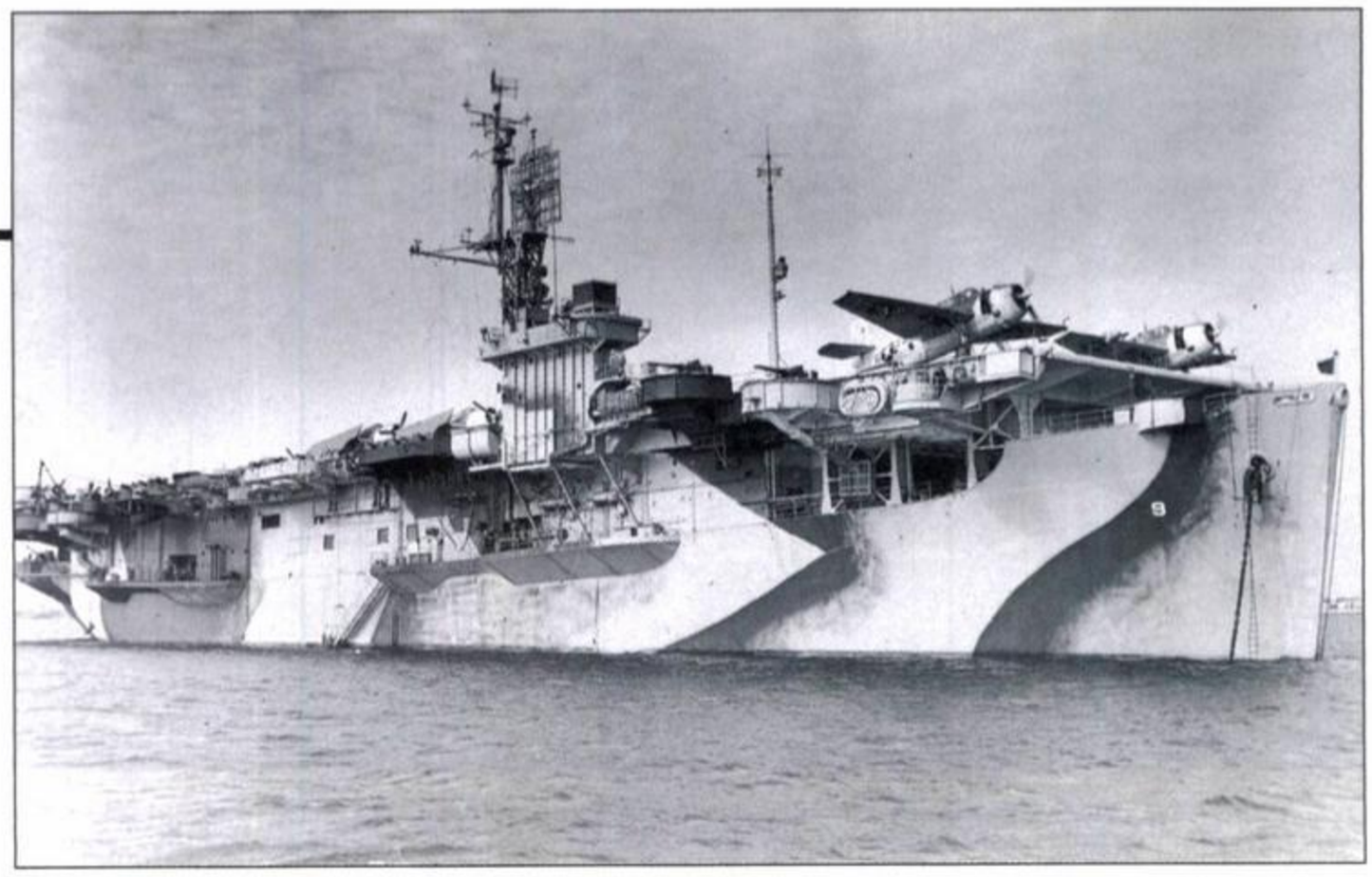
A later example of the Avenger tested at Boscombe was the TR.Mk III (TBM-3/3E), one of which, possibly JZ635, is shown in July 1945 with rocket stubs and ASH radar.

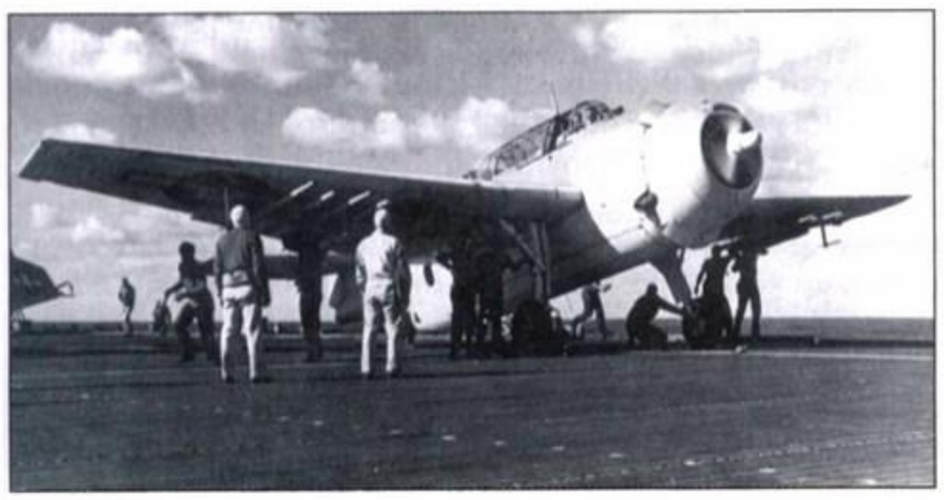
popular means of attack for Avenger pilots for the remainder of the war.

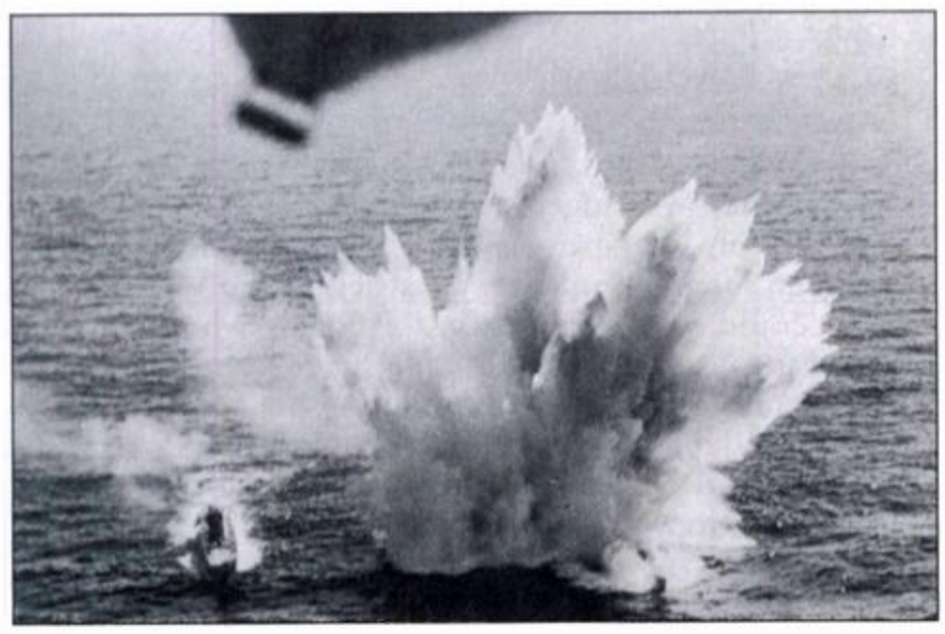
While the TBF-1 established itself in combat, Grumman worked with the US Navy to improve the design, and in one case radically alter it. On 2 July 1942, just under a month after the torpedo-aircraft debacle at Midway, the Navy authorised Grumman to develop a single-seat dual fighter/torpedo-bomber version of the Avenger. Displaying the hurry-up production of wartime, the company delivered the finished product in 24 days. With the ball turret, entire aft canopy and numerous other items deleted from the airframe – the turret replaced by 400 lb (180 kg) of ballast – the FTBF-1 weighed only 100 lb (45 kg) less than a conventional Avenger. Flight tests revealed an increase of only 10 mph (16 km) over the TBF-1, but it did possess a better turning radius than the F4F, then the Navy's frontline fighter. Nothing came of the design, and the test aircraft was reconfigured to its original TBF-1 appearance.

Battle of the Atlantic

The increasing toll on supply convoys taken by U-boat wolf packs in the North Atlantic in 1941 led to the urgent development of a new class of small escort carrier based on merchant ship hulls. The US CVE designs were being launched at a rate of one per week during the year beginning July 1943, and eventually 124 were commissioned for the USN and RN for use in all theatres. The aircraft complement of a US CVE was usually a composite (VC) squadron with a mix of Wildcats and Avengers. The first and most successful CVE hunter-killer group (which included destroyers) was that of USS *Bogue* (CVE-9), which was credited with 12 subs. VC-9, which flew off *Bogue* and *Card* (CVE-11), was the top-scoring squadron, with 12 'kills'. It was not all one-sided, however: the *Block Island* (CVE-21) was sunk by *U-549* in May 1944. The CVEs, with their rocket-, depth charge- and homing torpedo-equipped Avengers, did much to close the 'mid-Atlantic gap' in air cover, to the extent that U-boats only surfaced at night after mid-1943. *Guadalcanal* (CVE-60) and VC-58 pioneered night operations in April 1944, quickly scoring two 'kills'.

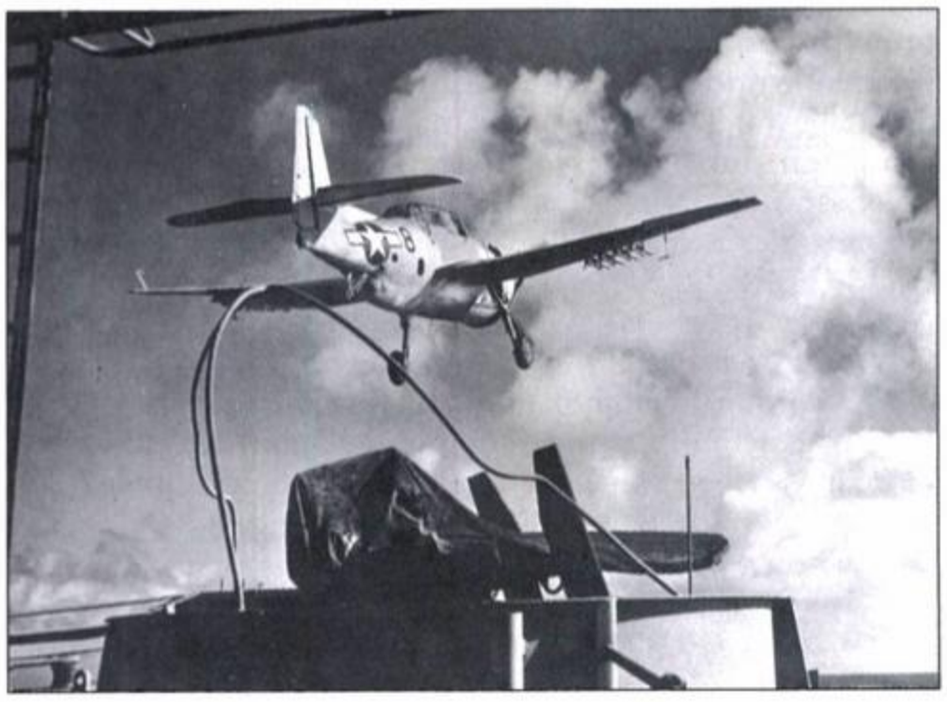






Above: The tailhook of Lt (jg) A. H. Sellenger's TBF-1 is visible in this photograph taken by his radioman of a direct hit by a Mk 24 mine on U-117*, a type XB 'Milch Cow'.* U-117 *was sunk by aircraft of VC-1 aboard USS* Card *(CVE-11) on 7 August 1943; the submarine it was resupplying,* U-66*, escaped.*

Another proposed alteration was the installation of a two-gun Martin turret, which proved not as effective as the single-gun turret because the synchronised guns stopped firing twice as many times to avoid sending bullets into the tail. Yet another TBF-1 participated in Project Yehudi, a Navy scheme that experimented with mounting lights on aircraft to make them difficult to observe when they flew against a bright sky. Four lights were installed in the cowling and 10 more on the leading edges of both wings of an Avenger at NAS Quonset Point in 1943. During one flight test, this specially outfitted TBF-1 could not be spotted at distances greater than 1.7 miles (2.7 km), while a standard aircraft was visible at 12 miles (19 km). While these special experiments occupied some time, the bulk of Grumman's attention was devoted to modifying the TBF-1, which resulted in the TBF-1C variant of the Avenger (the -1B was an export version). True to the pilot's wishes, the -1C replaced the cowl-mounted 0.30-in machine-gun with one



Above: The fourth of the CVE escort carriers, USS Bogue *(CVE-9) was commissioned in September 1942. It is seen at anchor in 1944 with a TBM-3 and a radar-equipped TBF-1D undergoing engine runs on the forward deck.*

Far left: Flight deck personnel aboard USS Mission Bay *(CVE-59) check the rockets on a TBM-1C of VC-9, 1 January 1944. The grey and white paint scheme for aircraft assigned to the Atlantic theatre is clearly visible.*

Above left: In June or July 1944, a rocket-armed Avenger leaves the deck of an escort carrier on another sub-hunting mission

Left: TBF-1Cs of VC-6 line the flight deck of the escort carrier USS Tripoli *(CVE-64) just prior to launch, 18 June 1944.*

One of the most extraordinary stories of the sea war was the capture of the U-boat* U-505 *by the 'Casablanca' class escort carrier* Guadalcanal *(CVE-60) in May 1944. With help from the destroyer escort* Chaterlain *(DE-149),* Guadalcanal*'s aircraft forced the submarine to the surface and a boarding party captured it. The U-boat was towed back to the US for analysis. Flight operations were continued even while the submarine was under tow, as seen here.* U-505 *is displayed today at the Chicago Museum of Science and Industry.

TBF-1Cs from NAS Sand Point on Lake Washington, Seattle display the red-bordered national insignia. This was unpopular because airmen believed it risked confusion with the red Japanese 'meatball'. The Marines in particular did not repaint many aircraft with the new style. This picture is dated August 1943.

0.50-in example in each wing and made provisions for auxiliary fuel tanks in the bomb bay and underneath the wings.

With Guadalcanal secured, the United States and its allies turned to an advance up the Solomons chain towards the Japanese bastion of Rabaul. Although carrier-based aircraft did stage raids during the campaign, the bulk of the air campaign during the offensive, which was codenamed Operation Cartwheel, fell to the land-based squadrons of Commander Aircraft Solomons (ComAirSols). ComAirSols could throw a wide array of aircraft at the enemy, from Army Air Forces B-25 Mitchell bombers to Royal New Zealand Air Force P-40s. TBF Avengers were well represented within the command, including three Marine Corps squadrons. Fighter pilots flying the dazzling new F4U Corsair received much of the glory in the Solomons, but the TBF was one of the true workhorses, displaying tremendous versatility.

Bombing Bougainville

The initial missions carried out by Avengers were strikes against Japanese airfields on southern Bougainville. George Bobb remembered logging a night bombing run against the island virtually every other night during April 1943. Enemy anti-aircraft defences could be heavy, especially on one mission in which the TBFs came in after Army Air Forces B-17 Flying Fortresses had unleashed their bomb loads against the target area. Bobb could see anti-aircraft fire winking in the darkness below, as well as a persistent searchlight that – despite all the twisting and turning the pilot could muster – seemed to continually follow his Avenger through the night sky. It was also at Bougainville that TBFs staged naval aviation's first aerial minelaying operation of the war. On 20 March 1943, 42 Navy and Marine Corps Avengers under the command of VMSB-143 skipper Major John W. Sapp dropped parachute mines from altitudes of 1,500 ft (457 m) during a night mission off the coast of Buin-Kahili in Bougainville. Not an aircraft was lost at this low altitude because of a diversionary strike by Army Air Forces heavy bombers that occupied the attention of Japanese gunners. However, the defenders learned their lesson and a subsequent minelaying effort in May resulted in the loss of four TBFs. Although the damage inflicted on the Japanese by these mines was at best uncertain, and laying minefields in

Hook runners rush to disentangle a TBF which has just trapped aboard an escort carrier. The large code letters suggest a training unit operating in US coastal waters and the insignia points to mid-1943 as the date.

Personnel aboard USS Hornet (CV-12) crowd 'vulture's row' to get a peak at the wreckage of a TBM-1C of VT-2. As in many Avenger accidents, a wing had separated at the weakest point – the fold line.

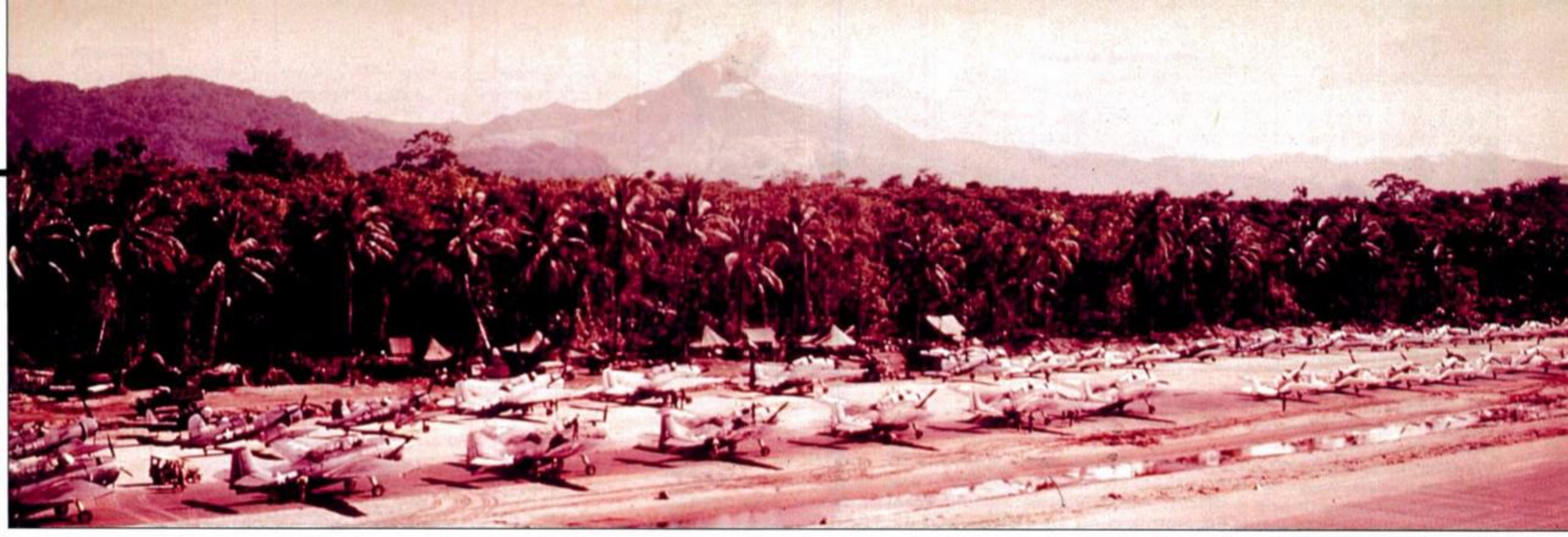
the well-defended waters proved risky, the seed was sown for further efforts later in the war.

An additional first for the Avenger was its role in the development of close air support, still in its rudimentary stages during early 1943. During the amphibious assault against New Georgia, the first step of Operation Cartwheel, aircraft received calls for 37 close air support missions and logged 1,883 sorties, many by TBFs. These initial efforts proved generally unsuccessful because not much territory separated the opposing forces on the front lines, and the dense jungle made accurate drops virtually impossible. Efforts in Bougainville proved more effective. On 13-18 December 1943, TBFs of VMTB-232 and VMTB-134, guided by coloured smoke grenades that marked friendly lines, made repeated runs against the Hellzapoppin Ridge, a heavily defended obstacle that had proven virtually immune to artillery shelling. On one day, 90 per cent of the bombs from 17 TBFs fell on the target area, and on 18 December 11 Avengers unleashed a rain of 100-lb bombs and strafed the enemy positions on the ridge, allowing the 21st Marines to take the ridge.

The capture of Japanese-held islands in the Solomons brought an increased number of airfields from which Allied aircraft could send raids against Rabaul, which was the scene of many great air battles. Avengers from Marine and Navy squadrons logged missions during the aerial campaign against the Japanese base, including carrier strikes in November and December 1943. Against shipping arrayed in Rabaul's Simpson Harbour, TBFs carried out traditional torpedo attacks or skip bombing in an effort to pound a bomb into the side of a vessel. Given the fact that the performance of US torpedoes was still unreliable, the latter tactic proved popular with aircrews. One squadron action report noted that "skip-bombing using delay-action fuses and co-ordinated with strafing by VF [fighter] escorts ... can be used with much greater effectiveness than torpedoes against all classes of ships up to and including CAs [heavy cruisers]." In addition, TBFs joined other aircraft in hammering the airfields surrounding Simpson Harbour. In this work, the 0.50-in machine-guns added to the wings proved invaluable.

The scene of intense air battles between fighters, the skies over Rabaul could be quite unfriendly for attacking

Below: A USN K-series blimp escorts USS Ranger (CV-4) and its TBFs in March 1943.



Lined up ready to give the Japanese a present they would not forget, Marine Corps Avengers join other aircraft, including RNZAF P-40s, on Bougainville on Christmas Day, 1943. This beachside airstrip is Torokina, and the active volcano Mt Bagana can be seen in the distance. Other fields were Piva 1 and 2, a few miles inland.

USMC Avengers taxi out at Piva for a strike. The Allied foothold on Bougainille was subject to occasional assault by the Japanese and the attentions of 'Pistol Pete', a naval gun hidden in the mountains. It covered three-quarters of the field, expediting take-offs.

Bougainville

Bougainville was the largest island in the Solomons and last bastion before the Japanese stronghold of Rabaul. The Allies established a foothold in November 1943 and quickly built airstrips under persistent Japanese shellfire and infantry assaults. Once Bougainville had been secured, it served as a base for attacks on Rabaul, forcing the Japanese to abandon it as a headquarters by March 1944. Among the many aircraft to support the landings and/or to be based on Bougainville were Avengers of VMTB-143, -232 and -233, and of Nos 30 and 31 Squadrons, RNZAF.

Marine TBF-1s line the airstrip on Munda, New Georgia, 6 December 1943. Note the mock machine-guns on the wing of the aircraft in the foreground, an attempt to confuse the Japanese into thinking the torpedo-bomber was a fighter.

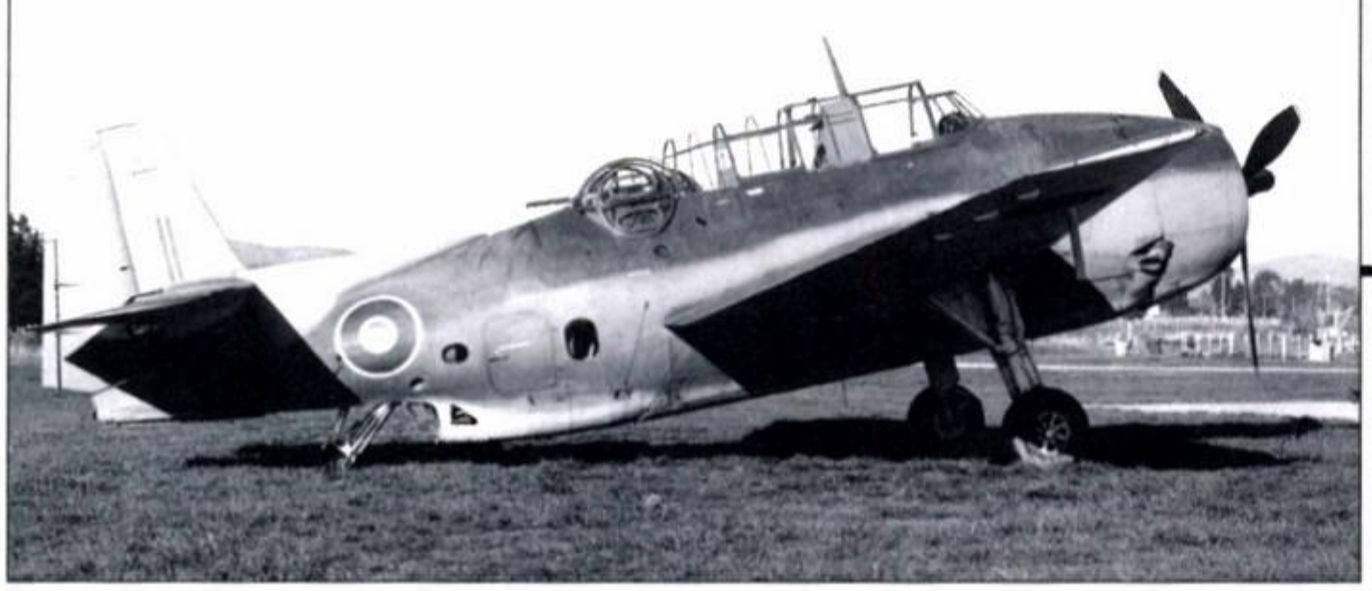
aircraft, especially Avengers making runs against their targets at extremely low altitudes. Japanese fighters would pounce on unsuspecting prey, while nearly 300 anti-aircraft guns filled the sky with lead. The tactic most pilots employed after pickling their ordnance was to get out as quickly as possible. Proof of the effectiveness of enemy defences can be found in the action reports of VT-17, a squadron based aboard USS *Bunker Hill* (CV-17). In two strikes, one each against Rabaul and Kavieng (the latter another base to the northwest), the squadron had three aircraft shot down, one so heavily damaged that it had to be pushed over the side, and six damaged. One aircraft that became separated from the others over Rabaul after making a second attempt to drop a torpedo hung up in its bomb bay paid the price with 207 bullet holes in its fuselage. Anti-aircraft fire at Kavieng broke a hydraulic line in another Avenger. The pilot managed to shake down the wheels and ingeniously had his gunner pour water from his canteen into the hydraulic tank to help get the flaps down for landing aboard the carrier. On 5 November 1943, when aircraft from *Saratoga* participated in the first carrier strikes against Rabaul, Commander Henry H. Caldwell, as was customary for air group commanders, remained over the target while a crewman in his Avenger took post-strike reconnaissance photographs. A flight of Zeros attacked Caldwell and his fighter escort, with the aircraft staging a running gun battle on the flight back to the carrier. The enemy fighters put 116 holes in the TBF-1, killing one crewman and badly wounding another – but the Avenger held together and Caldwell managed to bring it aboard without hydraulics, flaps or aileron control, and with one wheel shot away.

Increasingly encircled by Allied airfields, Rabaul's defences were rendered impotent and plans for an invasion were cancelled. Air power had neutralised one of Japan's most feared Pacific fortresses. On the other side of the world, Avengers were doing their part to combat another menacing foe.

Atlantic attacks

Unlike their counterparts in the Pacific theatre, Avenger crews in the Atlantic theatre did not have the multiple opportunities to fly traditional strike missions in fleet engagements at sea or against land targets. TBFs struck their first blow against the Axis in the Mediterranean Sea during Operation Torch, the invasion of North Africa in November 1942. Flying from the deck of USS *Ranger* (CV-4) – the first US Navy carrier built as such from the keel up – and three escort carriers, Avengers attacked Vichy French shipping, shot up enemy airfields, and hit enemy troop concentrations in support of Allied ground forces ashore. In

A two-ship section of VT-6 TBF-1s contrasts the colour and markings for carrier-based aircraft that the US Navy adopted in 1943. The aircraft in the foreground wears the two-tone blue-grey over grey scheme, while the Avenger in the rear sports the three-tone blue and white scheme. In addition, the national insignia has changed, with the addition of a bar and red border, the latter destined to last only a short time.



No. 30 Squadron converted to Avengers from antique Vickers Vincents in September 1943. One of the first arrivals, NZ2405, a TBF-1, is seen above at Gisborne. These early aircraft were not taken into combat but served into the 1950s in New Zealand.

RNZAF

The only nation other than the US and UK to receive Avengers during World War II was New Zealand. The RNZAF initially ordered 68 aircraft but this was cut to 48, comprising six TBF-1s and 42 TBF-1Cs. After training in New Zealand and with VMTB-32 at Espiritu Santo, two units (Nos 30 and 31 Squadrons) flew combat from Bougainville between March and July 1944. Eight TBFs were lost to Japanese anti-aircraft fire and many others were damaged. During May, 22 sorties were flown by US pilots in the RNZAF TBF-1Cs. Sixteen aircraft were returned to the USN in October 1944 and nine to the Fleet Air Arm in September 1945.

RNZAF armourers load 'the whole nine yards' of ammunition into the wing guns of TBF-1C NZ2523 of No. 30 Squadron/Servicing Unit at Piva on Bougainville. Flying and maintenance functions were divided for RNZAF combat types. No. 30 SU was responsible for the Avengers even after No. 31 Sqn arrived in May 1944. Note the 15 bomb symbols under this Avenger's windscreen.

Casablanca harbour, TBFs glide-bombed the partially completed battleship *Jean Bart* and so damaged the cruiser *Primauget* and destroyer leader *Albatross* that they had to be beached. Additionally, VGS-27 Avengers, armed with depth charges, caught the Vichy French submarine *Sidi-Ferruch* on the surface and straddled it before it could dive. Underwater explosions marked the demise of the submarine.

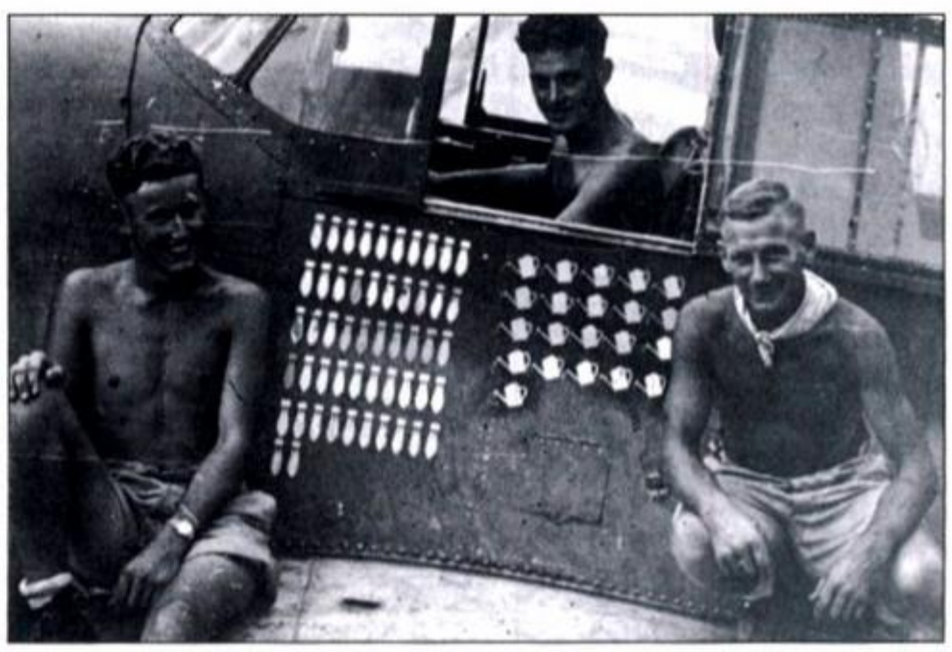
However, not all was rosy for the TBF during Torch. Hastily put into operational status, the escort carriers *Santee*, *Sangamon* and *Suwannee* possessed green crews that mirrored the inexperience of most of the pilots in the air groups aboard them. The practice aboard the former carrier was to line the starboard side of the flight deck with aircraft during launch, forcing VGS-29 and VGF-29 pilots to make deck take-offs through a narrow corridor along the port side of the flight deck, getting airborne just above stalling speed. Two Avengers ended up in the sea on 8 November, the first day of operations. As VGS-29 pilot Bill Anderson recalled, a pilot of one of the doomed Avengers, certain of his fate, thought to hand his watch to the plane captain before his ill-fated take-off. Four other TBFs were lost not to enemy fire, but to the elements. Diverted to an airfield at Safi for various reasons, deep mud that was not visible from the air prevented the crews from taking off, effectively taking them out of the battle.

It was almost a year before Avengers launched a carrier strike in the Atlantic. On 4 October 1943, 10 TBF-1s of VT-4 participated in a 42-aircraft carrier strike from *Ranger* against German shipping at Bodø, Norway, in the first US Navy carrier operation in northern European waters. Operation Leader resulted in the sinking of six steamers and heavy damage to four others. Two attackers fell to enemy anti-aircraft fire, including the Avenger flown by Lieutenant (jg) J. H. Palmer, which took a hit in the engine and caught fire. Only Palmer was able to parachute from the stricken craft, and he spent the remainder of the war in a

A pair of RNZAF Avengers, TBF-1 NZ2506 and NZ2544 (rear), is seen on a training flight in early 1944. The code letter was incompatible with the 'roundel and bar' insignia and would soon be removed, as on '44, which was written off following combat damage on 28 May 1944.

Below and bottom: Nose art and mission markings appeared on most of the RNZAF Avengers that saw active service. The watering can symbols represent spraying missions flown over Japanese vegetable gardens: in a procedure developed by VT-305, diesel delivered from a bomb-bay tank was ignited by the ventral gunner to deprive the enemy of a food source.

The pilot of NZ2321 arrives by jeep after a briefing. This aircraft was lost on 31 May 1944 during a strike on supply dumps at Talili Bay on the Japanese garrison island of Rabaul.



Markings
The insignia adopted by the RNZAF in the Pacific theatre were an interesting hybrid of British and US styles. Red was removed from the RAF-style roundels of aircraft destined for the Pacific during 1942, and the white bars appeared from late 1943 at the behest of the US forces in an attempt to make Allied aircraft more identifiable as such. Fin-flashes remained three-colour but were narrowed to minimise the area of red.

Offensive weapons
Although the Avenger was designed as a torpedo-bomber, bombs were by far its primary weapons. The TBF-1's bomb bay could carry 12 100-lb, four 500-lb or two 2,000-lb bombs. There was also provision for 5-in rockets on a variety of mountings, although they, like torpedoes and depth bombs, were not used by RNZAF Avengers.

Defensive armament
As well as the two wing-mounted 0.50-in machine-guns, the TBF-1C had a single 0.30-in 'stinger' gun in the 'tunnel' at the rear of the radio compartment. The turret, rotated electrically, mounted a single 0.50-in gun on the left side.

Grumman TBF-1C Avenger No. 30 Squadron, RNZAF Piva, Bougainville 1944

NZ2518 was flown by F/L Fred Ladd, later a well-known post-war civilian aviator and Grumman amphibian pilot. Ladd was a non-drinker and could think of nothing more insulting than having beer poured on oneself; this gave rise to *Plonky*, the flying beer barrel with the open tap. The aircraft was known to the Japanese, and 'Tokyo Rose' referred to it on one occasion as *Plocky*. In an eventful combat career, *Plonky* was damaged on 29 February by its own bomb, dropped at too low an altitude, and landed with punctured fuel tank. Sent to No. 4 Repair Depot at Espiritu Santo for rectification, it was damaged again on 10 May 1944 over Lukanai airfield on Rabaul, receiving holes in the port wing, a buckled cowling and a large hole in the port stabiliser. The canopy was damaged on 22 May. The aircraft was taken over by No. 31 Squadron on 25 May. It was lost on 5 June with its new crew of F/L G. Pryor, F/O S. Clayton and W/O T. Scarlett, having been hit by AA fire.

TBF-1C
The TBF-1C could be distinguished from the initial production TBF-1 by the absence of the 0.30-in machine-gun on the left upper cowling and its replacement by a pair of 0.50-inch guns, one mounted in each wing just inboard of the fold. The radio aerial mounted atop the canopy was positioned further aft and angled slightly rearwards compared to that on the TBF-1. Unlike USN TBF-1Cs, the RNZAF aircraft appear to have all retained the seat behind the pilot rather than filling this area with radio equipment, although the centre cockpit, which had a limited number of flight instruments, was not occupied on operations.

Above: Hellcats and Avengers pack the deck of* Yorktown *ready for a mass launch. Engines are running, making the deck a deadly place for the unwary. The green spinners were a hallmark of* Yorktown*'s air group. Note that one TBF retains national insignia atop the starboard wing.

Right: VT-80 TBM-1C No. 11 flies from USS* Ticonderoga*, 30 June 1944. A combat camera is fitted on the mount forward of the windscreen.

German prisoner of war camp. Another TBF-1, though damaged in the wing and engine, managed to return to *Ranger*. Like his counterparts in the Pacific, air group commander Joseph A. Ruddy, who had commanded VGS-29 in North Africa, discovered the effectiveness of glide-bombing against enemy shipping, concluding in his action report that "the Avenger is definitely the aircraft for this type of work."

U-boat hunter

The air operations in North Africa and Norway proved exceptions to the general pattern in the Atlantic. The farthest-reaching and most bitterly contested sea campaign in history, the Battle of the Atlantic involved thousands of ships, aircraft and seagoing personnel in a bitter war of attrition over thousands of square miles of ocean. On the one side were convoys plying the waters between North America and Europe, carrying troops, foodstuffs, fuel and other valuable cargo to support the battles against the Axis; pitted against them were menacing U-boat 'wolfpacks', hunters of the deep that shadowed the streams of ships waiting for the right moment to unleash torpedoes against their unsuspecting quarry. Between September 1939 and August 1942, German and Italian submarines sank 1,094 Allied and neutral ships totalling 9,235,113 tons. In the same period, Allied warships, aircraft and minefields sent 94 U-boats to the bottom. With such staggering losses on both sides, British Prime Minister Churchill remembered the struggle against the U-boats as "the only thing that ever frightened me during the war." Clay Blair's close examination of U-boat operations in his landmark study entitled *Hitler's U-Boat War* indicate that the effectiveness of the 'wolfpacks' was overblown, and that 98 per cent of the ships in Atlantic convoys during 1939–1942 reached Great Britain safely. However, what cannot be discounted is the U-boat's effectiveness as a weapon of terror, one that struck fear in all Atlantic sailors and one that Allied navies took great measures to destroy. Among the most effective ploy was aerial searches and attack, which involved to a great extent the Avenger.

In early 1943, with the Battle of the Atlantic still raging, the US Navy decided to employ escort carriers in the anti-submarine role. The first American ship of this type, USS *Long Island*, was a converted British merchantman commissioned on 2 June 1941. It served as the foundation for a new class of 'baby flat-tops', the 'Bogue' class, which was longer than the *Long Island* at 442 ft 3 in (134.79 m) and featured a single catapult, a small island structure, and larger hangar deck. USS *Bogue* was the first US Navy carrier to operate in protection of convoys in the Atlantic, followed by other groups of escort carriers, namely the 'Sangamon' class, 'Casablanca' class and 'Commencement Bay' class, all of which varied in size, displacement and capability. Operating from the decks of these ships were the US Navy's first composite squadrons, which usually included 12 TBF Avengers and 12 F4Fs (later TBMs and FMs). Together, they provided the escort carrier's offensive punch.

"There were probably more ordnance innovations going into the Atlantic Fleet than the Pacific Fleet," recalled Bill Anderson, who served in both theatres during World War II. "Atlantic Fleet aircraft were [also] the first to get good radars." The war against the U-boats was one greatly influenced by technology. The Avenger's inherent flexibility in the ordnance it could carry was ideally suited to the anti-submarine mission. Naval aircraft began the war carrying depth charges with an explosive weight of 300 lb (136 kg) and a sink rate of 8 ft (2.4 m) per second. However, more advanced ordnance joined this traditional method of combating submarines. Wing-launched rockets, first employed by the British in the anti-submarine role, proved effective because they could be unleashed against a submerging submarine more quickly than conventional ordnance. The standard rocket carried on the Avenger weighed 20 lb (9 kg) and was powered by a 3.5-in (8.9-cm) motor giving a velocity of 1,175 ft (358 m) per second. Initially, they could damage the pressure hull of a submarine after travelling 50 ft (15 m) underwater, a distance more than doubled by the end of the war. Another major innovation in anti-submarine warfare ordnance was the Mk 24 mine, which was actually a homing torpedo. Nicknamed 'Fido', the Mk 24 had a relatively low speed of 12 kt (14 mph; 22 km/h) and a limited range, but it proved to be a deadly addition to the arsenal that could be unleashed against undersea predators.

Not all weapons had an explosive capability. The CRT-1 sonobuoy could be dropped in a pattern around a suspected submarine location. Sounds picked-up by a 30-ft (9-m) deep hydrophone were relayed to an orbiting Avenger by way of a radio transmitter. Additionally, search

Deck handlers clear the landing area as a TBF-1 is waved off from the USS* Nassau *(CVE-16), 6 September 1943. The deck is fouled by another Avenger which needs attention of some kind. The CVEs with their tiny decks and the later CVLs, which were longer but narrower, demanded a lot from man and machine.

Flinging away its catapult bridle, an Avenger of No. 845 Squadron leaves the deck of HMS* Empress *in Far East waters, early 1945. Catapults were normally used to launch Avengers from escort carriers which, with a top speed of around 19 kt (35 km/h), often had trouble generating enough wind over deck.

FAA service

In July 1943, the first Fleet Air Arm personnel arrived at NAS Squantum, Massachusetts for training and to form the first FAA TBF Squadrons. The aircraft had come from Grumman via a Blackburn modification centre in New York. Seven units – Nos 851, 852, 853, 854, 855, 856 and 857 – were commissioned at Squantum, joining Nos 848, 849 and 850 which had formed at Quonset Point. Some other squadrons, including No. 845, went directly to sea from Quonset. Within a year, all units had dispersed to join the Home or Pacific fleets. In the Atlantic, particularly in the Arctic, they hunted U-boats (sharing in the destruction of two), escorted convoys and struck at shipping and shore targets in Norway. Shore-based units flew ASW, anti-shipping and minelaying patrols from UK shore bases. Five South Coast-based squadrons flew in support of the D-Day landings and the build-up to them from April 1944.

An Avenger TR.Mk II of No. 856 Squadron traps aboard **Premier** *in late 1944. The squadron was involved in operations off Norway and in escorting convoys to Russia.*

radars carried aboard the aircraft advanced in capability throughout the course of the war. The ASB could detect a surfaced submarine at a distance of 5 nm (6 miles; 9 km), a distance extended by later X-band radars to 15 nm (17 miles; 28 km).

Perhaps the greatest asset to aircraft operating in the Battle of the Atlantic was the vital intelligence on U-boat activities gained from cryptanalysts who had unlocked the secrets of Enigma, the German encoding machine used to transmit military messages. By reading the German message traffic, the so-called 'Ultra' intelligence allowed the allied high command to anticipate U-boat movements. Additionally, surface ships including escort carriers were outfitted with high-frequency direction-finding (HF/DF or 'Huff-Duff') equipment that enabled the Allies to pinpoint U-boat locations as they made their radio contact reports (later in the war the Germans were able to counter this with a burst transmitter called 'Kurier').

Vast search area

With their relatively wide range of operations, aircraft were the weapons most able to benefit from this intelligence. However, the sheer magnitude of the search areas in the Atlantic made capitalising on these benefits difficult. As Bill Anderson remembered, "We would fly search around the convoys. We put some [aircraft] close-in, circling the convoy, maybe five miles away from the convoy, and then we'd send searches out 300 or 400 miles ... [It was] an area too large to cover well enough. We began to get our radio direction finder locations of submarines, but they were so far away we never could really get a concentrated enough search to cover the whole area."

The standard routine for Atlantic pilots was flights lasting three to four hours, with night flying becoming part of the routine from 1944. In the latter flights, crews stripped Avengers of all armour and armament, replacing it with wing and bomb bay fuel tanks, parachute flares and other equipment. Lightened by over 450 lb (204 kg), these 'Night Owl' aircraft logged 13-hour missions, launching at dusk and returning at dawn. The Avenger, which one pilot remembered as a stable aircraft on approach, made the task of operating from the relatively small decks of the escort carriers easier.

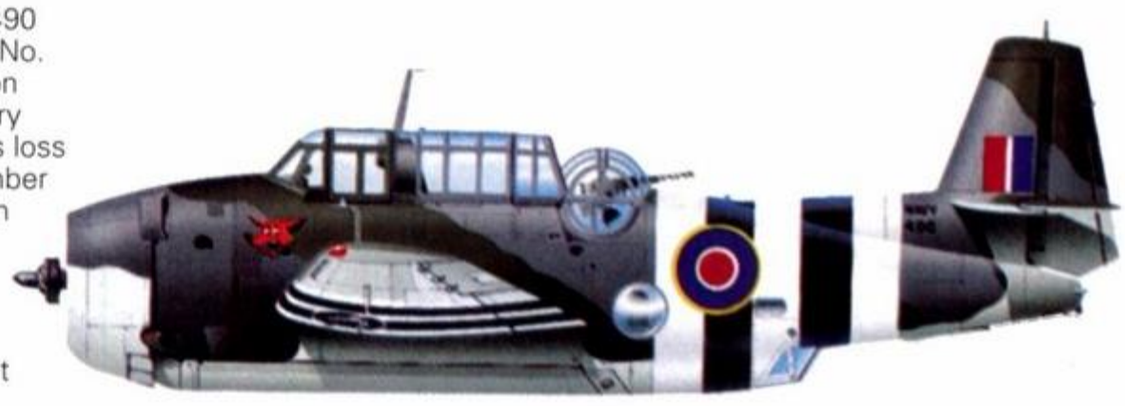
Above: This flight of Tarpon TR. Mk Is of No. 846 Squadron was photographed on 10 December 1943. The squadron was then at Macrihanish, and embarked on HMS **Tracker** *in January, transferring to* **Trumpeter** *in July 1944.*

Right: No. 846's Avengers aboard **Trumpeter** *served off Norway and in Arctic waters until April 1945.*

In the inherently dangerous business of carrier operations, accidents did occur. In one spectacular crash during a recovery aboard *Card*, a TBM stalled after a wave-off from the landing signal officer, losing its port wingtip on a gun mount as it spun into the water. The pilot, Lieutenant (junior grade) John H. J. Pearce, was knocked unconscious, and a radar officer was trapped in his fuselage compartment. After scrambling free of his ball turret, the third crewman, ARM2c Charles Foster, attempted to pull his pilot from the

FAA Avengers

FN908, a TR.Mk I, began its career in September 1943 with No. 846 Squadron, aboard HMS *Trumpeter*. It later moved with No. 852 Sqn to HMS *Nabob*.



TR.Mk II JZ490 served with No. 855 Squadron from February 1944 until its loss on 4 September off the Dutch coast. Around D-Day, the squadron was based at Hawkinge.

Marine Corps TBF-1Cs of a training unit fly in formation over the western United States, May 1944. Note the mix of insignia styles, including the pre-29 June 1943 style on **Tex Ann** *in the foreground. The USMC's own bases in the west were all in California, and included El Centro, Mojave, Santa Barbara and Gillespie.*

Above: By August 1945, TBF-1s such as BuNo. 06146 had been relegated to training. This incident happened aboard the paddle-wheel training carrier USS **Sable** *(IX-81) on 2 August. The pilot was Ensign W.D. Henderson who can be seen waiting patiently to be lowered back to the deck. At least three Avengers have been recovered from Lake Michigan, having crashed during training with the Great Lakes training carriers.*

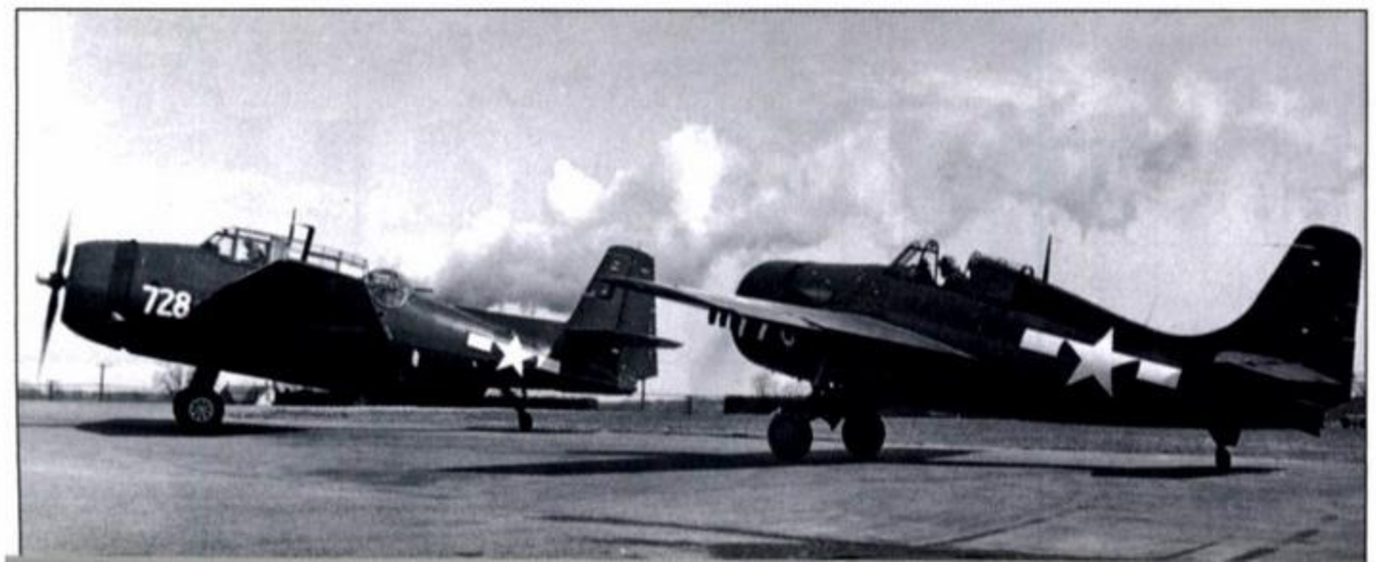
aircraft, only to discover that he was too heavy. Ingeniously, the young sailor waited for the cockpit to begin to fill with water as the aircraft sank, inflating Pearce's life vest at the right time so that the rising water would lift him from his seat. His quick thinking earned Foster a spot promotion and a decoration.

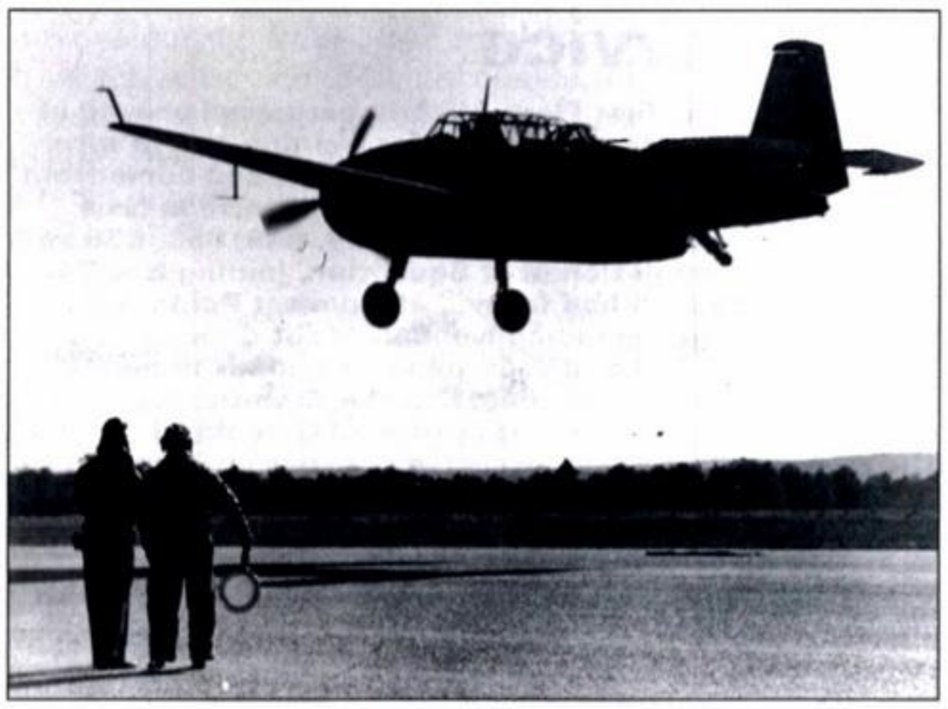
With the escort carrier's limited speed, take-offs were most often by catapult. As Bill Anderson remembered, "The biggest problem was having enough wind over the deck. Escort carriers could just barely make 18 kt and you did need 25 to 30 kt to make a deck take-off. Most of the time we made catapult take-offs, which eased our minds a lot about wind over the deck because the catapult was going to get you in the air. A deck run [in] a TBF/TBM was such that you didn't have much room ... We were in love with that catapult."

Thwarting Hitler's 'Wolfpacks'

A factory-fresh TBM-3E and an FM-2 Wildcat run up together. General Motors' Eastern Aircraft Division built both types in greater numbers than the parent company – 5,837 of 7,825 Wildcats and 7,546 of 9,839 Avengers.

TBFs scored their first U-boat kill on 22 May 1943 when, aided by 'Huff-Duff', an Avenger piloted by Lieutenant (junior grade) William F. Chamberlain pounced upon the unsuspecting *U-569*, driving it under. Shortly thereafter, the submarine surfaced, only to be hit by another TBF, this one flown by Lieutenant H. S. Roberts. This second attack drove it under again, and it took all the efforts of the crew to blow its tanks and bring the mortally





A necessary part of a naval aviator's training – then and now – was Field Carrier Landing Practice (FCLP). Here a TBM-1C of Special Task Air Group (STAG)-1 takes the cut at Traverse City, Michigan, circa 1943.

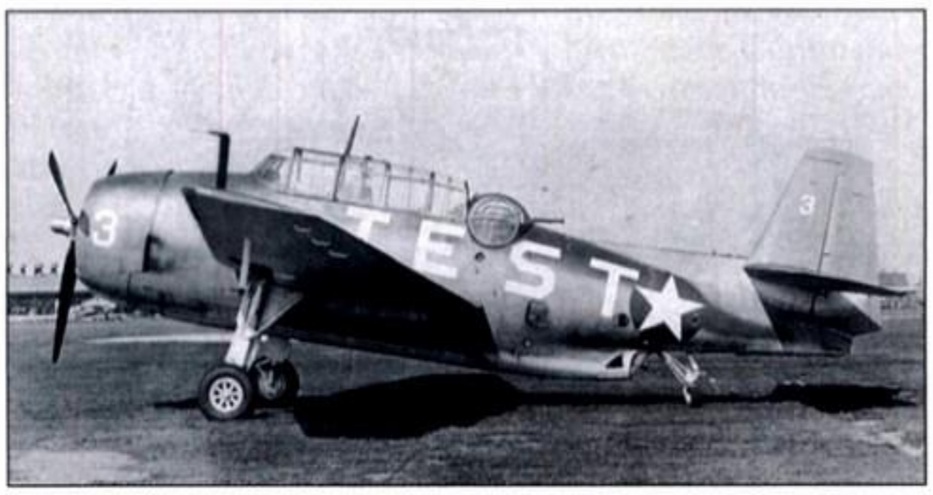
wounded boat to the surface. There it was raked by machine-gun fire from both Chamberlain and Roberts in an attempt to keep the Germans aboard and prevent them from scuttling the vessel. However, this proved unsuccessful and *U-569* plunged to a watery grave.

Subsequent months brought a variety of actions for Avenger crews. In August 1943 Lieutenant (junior grade) Asbury H. Sallenger of VC-1 aboard USS *Card* experienced the highs and lows of U-boat hunting. On 7 August he happened upon a pair of boats positioning themselves for a refuelling rendezvous. Attacking out of the sun, Sallenger dropped two depth bombs, causing enough damage to *U-117* to prevent it from submerging. Squadronmates finished off the helpless U-boat with a pair of 'Fidos'. The very next day, Sallenger and a fighter escort were patrolling the vast expanse of the Atlantic when he again discovered two U-boats on the surface. Boring in for an attack, he came under intense anti-aircraft fire, which ignited a fire in the bomb bay and knocked out his radio and electrical equipment. A second pass against the submarines was met by another hail of bullets, which tore into the port wing and crippled the aircraft's hydraulic system. The fire also apparently killed radioman D. J. Downes. Jettisoning his ordnance, Sallenger set down his mortally wounded Avenger in rough seas. He and his remaining crewman, AMM3c James H. O'Hagan, were rescued after six hours in the water.

Avengers and surface ships often complemented each other in successful encounters against U-boats. *U-66*, which had narrowly escaped the attack by Sallenger on 7 August,

A flight of TBM-3Es is seen on a cross-country delivery flight. The white numbers are the last three digits of the Bureau Number, used until the aircraft were issued to navy units. Note the passenger in the nearest aircraft. Normally, TBM-3s did not have a seat in the centre cockpit.

This XTBF-3 prototype makes no secret of its experimental status. Grumman and Eastern built a total of six XTBF and XTBM prototypes to test the new engine and cooling gills of the 'dash-three'.



was operating west of the Cape Verde Islands on the night of 5-6 May 1944, when it popped to the surface 3 miles (5 km) from the escort carrier *Block Island*. The ship's radar promptly picked it up and, after unsuccessfully vectoring an escorting destroyer, cleared the area for fear of a night torpedo attack. To the assistance came one of the carrier's night hunters, a VC-55 Avenger on patrol. According to *Block Island*'s official history, "At 03.30, 6 May, Lt (jg) Jimmie J. Sellars, USNR, an Oklahoma lad called 'Geronimo' ... got a definite radar contact, followed it in, and found himself, unarmed, in bright moonlight, sitting over the fully surfaced and speeding *U-66*! Sellars, completely without means to attack, stayed over the submarine despite intermittent gunfire. Reporting his find to *Block Island*, he was ordered to coach [the destroyer] *Buckley* in for attack. Once, eager to take some direct part, he dived down and emptied his Colt 45 at the conning tower." *Buckley*, the ship that had missed making contact earlier, did not make the same mistake twice, opening fire at a range of 2,100 yd (1920 m) and sending a salvo into the conning tower of the submarine. Coming alongside *U-66*, the destroyer raked it from stem to stern and rammed it. After hand-to-hand fighting reminiscent of sea battles of another era, the two vessels separated briefly but eventually came together once again. This time a US sailor tossed a hand grenade into *U-66*'s open hatch, setting off an explosion inside the submarine. The veteran of 10 war patrols that had netted over 30 ships sunk, *U-66* sank at 04.39.

Although Avengers by no means turned the tide in beating back the U-boat threat, they were a successful part of the team that countered the German submarine force. All told, aviation units aboard escort carriers helped to sink 34 U-boats during World War II.

Changing of the guard

By 1943 the TBF Avenger was a 'turkey' with many feathers. The basic TBF-1 design introduced early the previous year now included numerous variants, including the more heavily armed TBF-1C, the radar-equipped TBF-1D and TBF-1E, an experimental TBF-1L with a searchlight installed in the bomb bay, and the TBF-1CP and TBF-1P, photo-reconnaissance versions of the aircraft with provision for cameras in the bomb bay. Additionally, the aircraft had gone international in the form of the TBF-1D. A total of 402 of these aircraft, complete with British markings, was built for service in the Fleet Air Arm under Lend-Lease.

In January 1943, Grumman began work on the latest model of the aircraft, the TBF-3. A single TBF-2 with a Wright XR-2600-10 two-stage supercharger engine first flew in May 1942, but the predominantly low-altitude work of the Avenger made production of this version unnecessary. Developments in the original design had resulted in a weight increase of 2,450 lb (1111 kg), with a corresponding decrease in performance, especially on the take-off run. The Navy requested that Grumman employ the experimental Wright R-2600-20 engine on the TBF-3,

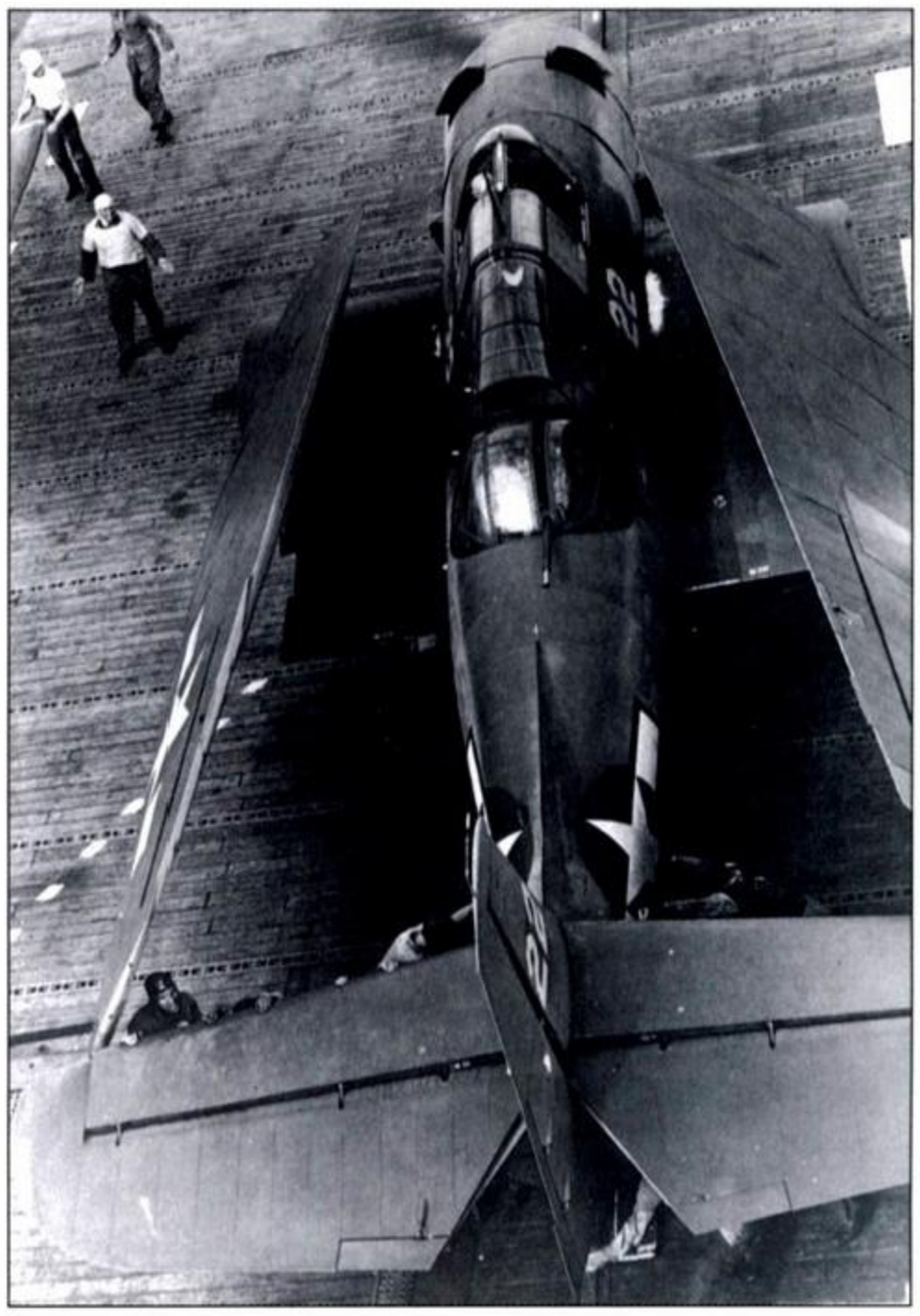
Variants

In addition to the basic TBF/M-1 and TBF/M-3 models and their later derivatives for AEW/ASW and COD roles, there were many sub-variants of the Avenger, and a number of prototypes for new models that met with varying degrees of success. As an example, the XTBF-2 was the prototype for a major production model with a two-stage Wright XR-2600 engine. The low-level nature of most Avenger missions made this unnecessary and only one such aircraft (BuNo. 06307) was completed.

The TBM-3D was, like the TBF/M-1D , modified for night bombing. The main equipment for this role was the ASD-1 radar on the starboard wing. The ASB aerials were relocated to the top of the wing. A large searchlight could be carried.

BuNo. 24241 later became the testbed for the Halford H-1B turbojet planned for the Curtiss XF15C-1 mixed-powerplant fighter. It is seen here in a derelict condition after its test career was over.

Three XTBM-4s were built with beefed-up structures to withstand higher g loads at greater weights. Successful tests were conducted by NATC in June 1945, but the war ended before production could begin.



This unusual overhead view of a TBM-1D of VT(N)-41 was captured aboard USS **Independence** *(CVL-22), 10 October 1944. At the time of this photograph, 'Indy' was one of the Navy's dedicated night carriers.*

A TBF-1C of VT-2 taxis forward after landing aboard* Hornet *with battle damage, on 13 June 1944, just prior to the Saipan landings. VT-2 was perhaps the only wartime combat Avenger unit to regularly carry squadron insignia.

which would give a much-needed 200 hp (150 kW) more. The new powerplant provided some interesting moments for Grumman test pilots over the coming months for, unknown to them, their flights would be the first time the powerplant had been operated in the air. During the course of flight testing, 'Corky' Meyer endured three engine failures, two during full-power climbs and one before he had even cleared the runway at Bethpage. The latter was a harrowing flight.

"As the wheels were retracting and just as we passed the boundary of the runway, another Curtiss-Wright R-2600-20-engine-furnished BOOM came from up front as engine power deteriorated immediately from 1,900 hp to less than 300 hp at full throttle ... I didn't have to make up my mind that the shortest way to bypass [the town of] Bethpage was to make a left turn and hope that the engine didn't quit entirely while making the gentlest, shallowest turn I've ever made ... Smoke was starting to appear over the wing next to the fuselage ... I then called the tower to ask how much smoke they saw. They said that I was below treetop level, and they couldn't see me. So I decided to climb slowly up a few feet to give them a clear view of my abysmal situation. The engine was running very rough but still holding its meagre power. By this time I noted that I had completed a 180° turn ... By now, the smoke was getting quite dense and oil was splashing all over the windshield, with much of it coming into my open canopy and onto my goggles ... Since the engine was still running, albeit disobediently, and keeping the airspeed barely above the stalling speed, I elected to continue another 180° turn to make a very short landing approach back at Grumman ... During the flaps-up landing roll-out, at about 50 kt ground speed, Bennie [Meyer's mechanic who had begged to go along on the flight] had decided his ride was over. He bailed out the rear door onto the runway, totally unbeknownst to me."

No further problems were reported with the engine during the remainder of the TBF-3 flight tests – because all future engines installed on the aircraft completed a 100-hour full-power test on the ground first.

The flight testing of the TBF-3 by Grumman was a swansong of sorts. In 1942, with the Navy clamouring for great numbers of the company's F6F Hellcat fighters, the decision was made to free up production lines by subcontracting production of the TBF Avenger and F4F Wildcat to the Eastern Aircraft Division of General Motors Corporation. It was not an uncommon arrangement during World War II, during which many automotive manufacturers, including Ford and Goodyear, turned to the production of aircraft. Using parts provided by Grumman, Eastern Aircraft built its first TBM (the M was the designation for General Motors in the Navy designation system) in November 1942, and by September 1943 was outpacing Grumman in production of the design. Of the 9,838 Avengers produced during World War II, 7,546 of them rolled off Eastern assembly lines.

The mountains of Oahu form a backdrop for a trio of TBM-1Cs of VT-27, 16 January 1944. Note the exhaust flame damper.

Armed with rockets, a quartet of VT-15 Avengers heads towards Guam on the day the island was invaded by US forces, 15 July 1944.

TBM-1Cs of VT-6 run up aboard the famed 'Big E', USS* Enterprise. *Radial-engined aircraft such as the Avenger had an advantage over inline liquid-cooled types for carrier operations as they could warm up and wait for much longer without overheating.

Hunters in the night

One of the more successful uses of the Avenger during the Pacific War was in night operations. Begun in April 1942, the US Navy's Project Affirm centred on the development of equipment and tactical doctrine for night-fighters. The first nocturnal squadrons to join the fleet were VMF(N)-531 and VF(N)-75. However, it was VT-6 operating from the deck of the venerable 'Big E' that scored naval aviation's first night kills of the war.

Flying in support of the invasion of the Gilbert Islands in November 1943, American carrier-based aircraft were under threat from land-based Japanese aircraft, particularly at night. This fact hit home on 20 November when a group of bombers attacked the light carrier USS *Independence* (CVL-22) at dusk, planting one torpedo in its side and knocking it out of the war for eight months. The blow confirmed the opinions of Rear Admiral Arthur W. Radford. No US carrier at the time carried night-fighters, but to Radford's mind the threat was so great that, even before American flat-tops entered the waters around the Gilberts, he had hatched a plan to develop a makeshift night-fighter group aboard *Enterprise*. Commander Edward H. 'Butch' O'Hare, famous ace and air group commander aboard *Enterprise*, initially chose the TBF-1 and -1C aircraft of VT-6 for the mission. Though the lumbering torpedo-

bombers lacked speed, they were the only aircraft aboard that carried any sort of radar, limited though the ASB-1 equipment was in the range it could pick up an aerial contact. The Avenger also had the advantage of endurance. Eventually, O'Hare, VT-6 skipper Lieutenant Commander John Phillips and radar operator Lieutenant (junior grade) Hazen B. Rand settled upon a tactic in which one TBF-1C and two F6F-3 Hellcat fighters would operate in V-formation. Flying in the lead position, the radar-equipped Avenger would guide the fighters to the stern and one side of an incoming Japanese formation, and then vector them to the exhaust flames of particular enemy bombers. The Hellcats could then do their stuff.

The 'Black Panthers', as the nocturnal fliers called themselves, logged the US Navy's first night-fighter mission on the evening of 22-23 November. Not until the evening of 26 November did they have another opportunity, when Phillips took to the sky in his Avenger with O'Hare and Ensign Andy Skon to hunt for Japanese snoopers. Put on the trail of a formation of twin-engined bombers by *Enterprise*'s fighter director officer, Phillips guided his aircraft to within 2,000 yd (1828 m) of the enemy intruders with the assistance of Rand in the belly of the Avenger. After obtaining visual contact on the exhaust flames of one of the G4M bombers, which were codenamed 'Betty' by the Allies, the VT-6 skipper squeezed the trigger, sending streams of tracers from his forward-firing 0.50-in guns into the wingroot of his quarry, which exploded and fell into the sea. Over the radio in the Combat Information Center aboard *Enterprise* came the words "Scratch one of the bastards," a fitting epitaph to naval aviation's first night kill. The unlikely hunter bagged another 'Betty' a few minutes later when he happened upon a pair of circling enemy bombers awaiting a rendezvous with other aircraft.

These successes did not come without a price, though. While forming up with Phillips's TBF in the darkness, 'Butch' O'Hare's F6F was hit and he fell into the sea. For years it was thought that the Avenger's gunner, AO1 Alvin Kernan, had shot him down, but recent scholarship offers convincing proof that a 'Betty' nose gunner mortally wounded the famous fighter ace and Medal of Honor recipient.

Ordnance handlers manoeuvre a torpedo under a TBF-1C of VT-51 on* San Jacinto *(CVL-30) during the Battle of Cape Engano, part of the Philippines campaign. The 'tinfish' appears to be a ring-tailed Mk XIII Mod-2 with an additional breakaway plywood box on the tail and a protective nose cap that would be removed before loading.

Cockpit window open, the pilot of this* Yorktown *TBF-1C keeps an eye on the camera plane, somewhere near Guam, 5 September 1944. The rocket rails are the British Mk 4 type, later superseded by Mk 5 'zero-length' stubs. The diagonal white band on the tail is a* Yorktown *air group marking, not to be confused with the carrier landing assistance stripe found on some aircraft, which was similar, but angled the other way.

On 18 September 1944 an empty gas tank forced Lt (jg) Clark Miller of VC-75 on* Ommaney Bay *(CVE-79) to make a forced landing on a shell-pocked runway on Peleliu. In so doing, his became the first aircraft to land on the embattled island, only four days after the Marines had landed. His aircraft is a TBM-1CP.

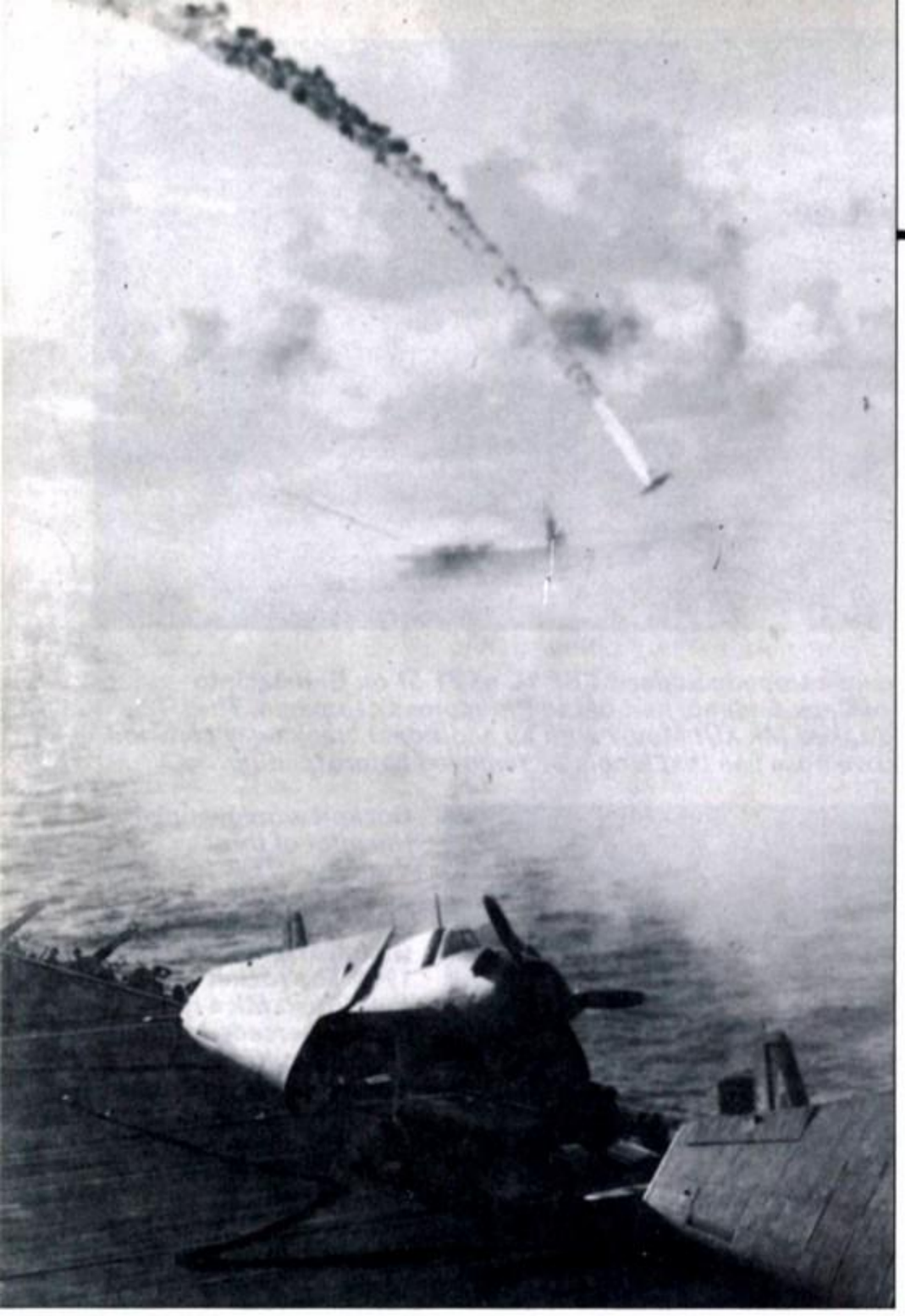
Night bombers

While the 'Black Panthers' were paving the way in the Central Pacific, VT-10 under the command of Lieutenant Commander William I. Martin prepared itself for nocturnal missions. The skipper had long been an advocate of the mission, having submitted a report as early as 1942 proposing the formation of six-aircraft reconnaissance units aboard carriers for night scouting and attack. He drove his troops hard, sending them through radar and gunnery schools during work-ups at NAS Seattle, and drilling the pilots in instrument flying and formation. Operating from Maui in November-December 1943, the 'Buzzard Brigade' scheduled flights every night, regardless of the weather. During this time, crews staged effective mock attacks against ships operating in the waters surrounding the islands, in some cases approaching to within 300 yd (275 m) of a floating target before being visually spotted. By the time the squadron boarded *Enterprise* in January 1944, it eagerly awaited the first opportunity to strike a blow at the enemy.

It came on 17 February 1944, when 12 TBF-1C Avengers, each armed with four 500-lb bombs, launched into a clear night sky for an attack against Japanese shipping at Truk Atoll. Attacking at one-minute intervals from two initial points, the aircraft faced heavy anti-aircraft fire once they crossed the reef surrounding the anchorage. Although one aircraft fell and seven others were damaged, the Avengers remained over the target nearly half an hour, making repeated single-salvo runs. Hindered by interference from surrounding land masses that disrupted signals, radar operators could provide only marks to guide the pilots towards targets. However, the favourable weather allowed visual bombing runs from 250-ft (76-m) altitude at 180 kt (207 mph; 333 mph). Masked in the darkness, VT-10 inflicted heavy damage on enemy shipping, sinking or beaching 13 ships. When compared with daylight attacks the results were impressive, with 52 per cent direct hits at night compared to 22.2 per cent during the day. Making their way up the chain of command, the results were noticed, signalling a bright future for night operations.

Eventually, the Navy adopted the concept of an all-night air group, forming Air Group 41 in *Independence* (CVL-22) while at sea in August 1944. *Enterprise*, from whose deck the first night operations had been conducted, also became a nocturnal flat-top, entering combat in December 1944. The venerable *Saratoga* (CV-3) and *Bon Homme Richard* (CV-31) rounded out the carriers operating night air groups. Equipped with TBM-1S, -3D and -3E Avengers, night torpedo squadrons, designated VT(N), flew some

Although this TBF-1C (BuNo. 24249) has caught the wire, its landing on this unidentified ship resulted in a barrier crash, on 24 September 1944. Unlike today's carriers, wartime CVs had up to 14 wires, sometimes with a few at the front end for 'over the bow' landings. Wire risers can be seen along the white deck line.

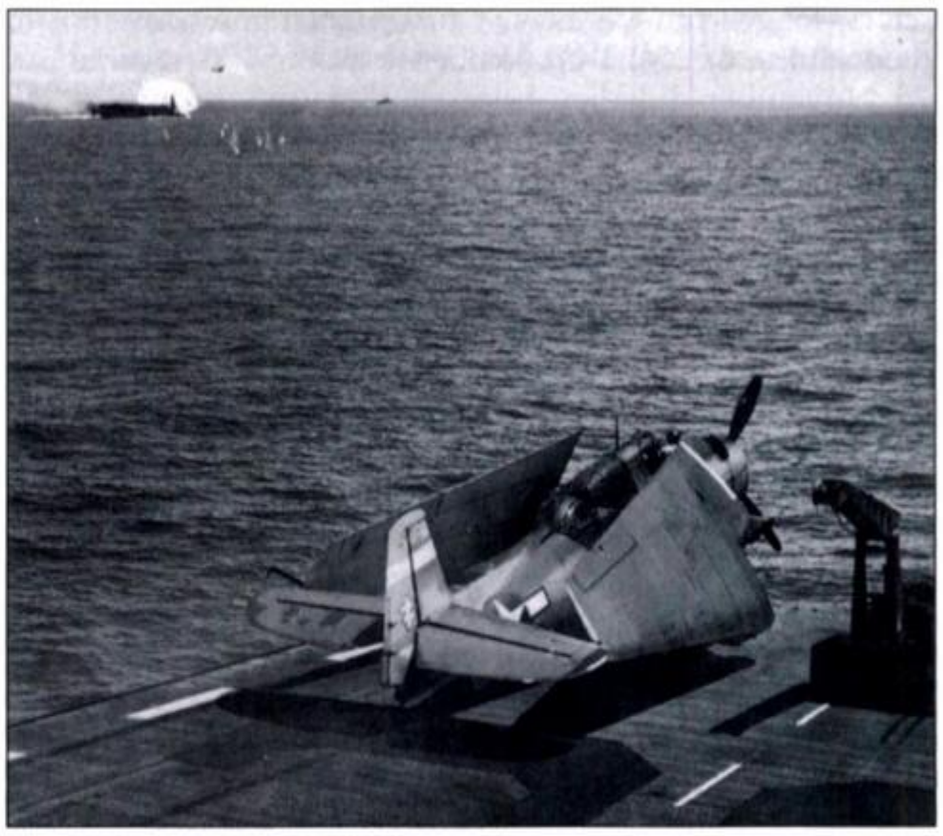


Kamikaze

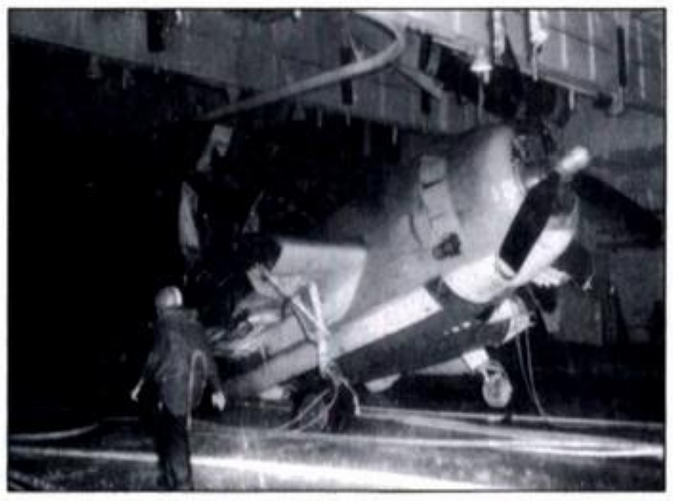
The Second Battle of the Philippine Sea in October 1944 saw the emergence of a new threat to the Allied navies – kamikaze or suicide attacks. Kamikaze pilots were ordered to attack carriers as a first priority and they claimed a large number, particularly escort carriers damaged and disabled. From Task Force 77 in the Philippines, *St. Lô* with 12 TBM-1Cs was sunk, *Sangamon* (CVE-26), *Suwannee* (CVE-27), *Santee* (CVE-29), *White Plains* (CVE-66), *Kalinin Bay* (CVE-68), and *Kitkun Bay* (CVE-71) were damaged, as were *Intrepid* (CV-11) and *Belleau Wood* (CVL-24), all equipped at that time with TBM-1Cs, in addition to other types. During the Okinawa invasion of March-June 1945, TF 52 carriers *Natoma Bay* (CVE-62) with TBM-1C and -1CP and *Wake Island* (CVE-65) with TBM-3s were hit. Task Force 58 carriers damaged, and their Avenger variants, were: *Wasp* (CV-18) (TBM-3), *San Jacinto* (CVL-30) (TBM-3), *Enterprise* (CV-6), twice, (TBM-3D), *Franklin* (CV-13) (TBM-3), *Randolph* (CV-15) (TBM-3), *Essex* (CV-9) (TBM-3), *Bunker Hill* (CV-17) (TBM-3), *Hancock* (CV-19) (TBM-3), *Yorktown* (CV-10) (TBM-3, TBM-3P), *Intrepid*, twice, (TBM-3). It is estimated that 5,000 kamikaze pilots had been killed by war's end.

Left: On 18 June 1944 this flaming J1N1 'Irving' dove on Coral Sea *during the invasion of Saipan, as seen from* Kitkun Bay. *TBM-1Cs of VC-5 are visible in the foreground.*

Right: Struck by a 'Zeke', the deck of Suwannee *(CVE-27) erupts in a fireball. Both* Suwannee *and* Sangamon *(CVE-26), from which this photo was taken, had been hit by kamikazes the previous day, 25 October 1944, off Leyte.*



Gunners fire their 20-mm guns directly upwards and deck crew freeze or flinch as a Japanese dive-bomber plunges at their carrier off Leyte, October 1944.



Fire-fighting water drips over a mangled VT-12 TBM-3, written off by a suicide attack on* Randolph *(CV-15) at Ulithi on 11 March 1945.

fake runs to confuse the defenders. Employing radio countermeasures (RCM), which made its first appearance in the fuselages of Avengers during 1944, crews could jam enemy radar-controlled defences, greatly improving their chances. 'Window', thrown out the side door of the fuselage, also proved effective.

In addition to strike missions, Avengers flew nocturnal scouting hops, scoring their greatest success during the Battle of Leyte Gulf. Operating in dark, stormy weather on the night of 24 October 1944, TBMs of VT(N)-41 tracked Vice Admiral Takeo Kurita's force heading through the San Bernadino Strait, with one pilot dropping to an altitude of 200 ft (61 m) to ascertain the elements of the force. The following night, another pair of nocturnal Avengers employed radar to spot an enemy carrier force operating north of Luzon.

In the tradition of Lieutenant Commander Phillips of VT-6, night Avengers could also wreak havoc upon aerial targets, with one VT(N)-90 pilot knocking down three aircraft, two at night. By war's end, nine VT(N) squadrons were in existence, and Avenger crews could be proud of their pioneering role in the evolution of night operations, a mission that continued in the post-war era. As the VT(N)-90 progress report concluded in 1945, "The feasibility of night carrier operations has been proven. Working under the most difficult conditions, the 'guinea pig' night air groups have shown that night offensive and defensive [flights] can be expeditiously and economically executed."

Fleet action

In June 1944 the Central Pacific drive reached the Marianas, the gateway to the west for the Allies. The central point of Japan's network of island defences in the Pacific, their capture would be a major blow to the enemy, a fact which almost guaranteed that the Japanese fleet, long dormant, would engage the Fifth Fleet. The carriers of Task Force 58 launched their first strikes against the Mari-

Below right: Damage control crews hose down TBM-1Cs of VT-21 to save them from the fires raging aft on* Belleau Wood *(CVL-24), 30 October 1944.* Franklin *(CV-13) burns in the background.

anti-shipping strikes, but as the war progressed their primary mission became night heckling sorties against airfields. For these attacks, the Avengers usually carried 12 100-lb bombs, effective in holing runways, which they dropped from altitudes as low as 1,000 ft (305 m). Operating individually, the torpedo-bombers used deception to their advantage, flying patterns that to Japanese radar made them appear to be friendly aircraft returning to base, and making

Below: A TBM flies across the bows of the 'new' USS* Yorktown. *At the time of the Okinawa landings, in March 1945,* Yorktown *carried seven Avengers of VT-9, as well as 15 SB2Cs. Struck by a kamikaze on 18 March,* Yorktown *was out of the battle until 27 June, when its reformed air group included VT-88.

Avengers form up for a strike on the Pangkalan Brandan oil refinery in Sumatra on 4 January 1945. Four carriers were involved in Operation Meridian, the campaign against Japanese oil production in the East Indies: Indomitable *(with No.845 Squadron Avengers),* Illustrious *(854),* Victorious *(849), and* Indefatigable *(820).*

FAA Pacific Avengers

The first British Avengers to see action in the Pacific were those of No. 832 Squadron which embarked on USS *Saratoga* and supported the landings in the Middle Solomons in June 1943. In all, six large and several small British carriers saw combat with East Indies and British Pacific fleets, and the following Avenger squadrons were embarked at one time or another: Nos 820, 828, 832, 851 845, 848, 849, 854, 857 and 885. The Avenger squadrons supported the US Pacific Fleet in a number of the invasions and strikes on Japanese-held islands, but are best remembered for the attacks on Japanese oil refineries in the Dutch East Indies in early 1945. The armoured decks of the British carriers made them much less vulnerable to kamikaze attacks; *Illustrious, Victorious, Formidable* and *Indomitable* were all hit by kamikazes in April and May 1945, but none was forced to withdraw from combat.

anas on 11 June, 3½ days of pre-invasion 'softening-up' of the islands. The strikes marked the first use of 3.5-in rockets by Avengers in the Pacific, though the heavy anti-aircraft fire in the Marianas proved more hazardous than U-boats when making rocket runs, given the relatively slow speed of the aircraft. As one squadron action report noted, " ... the rocket is a weapon of dubious merits penalising an airplane already extremely vulnerable to the attacks demanded it."

Meanwhile, the Japanese Mobile Fleet sortied for the Marianas. US submarines spotted the force in transit and intelligence picked up radio contacts indicating the imminent arrival of the enemy. Its commander, Vice Admiral Jisaburo Ozawa, planned to launch his aircraft while he was still out of range of the American forces, using Guam as an unsinkable carrier on which they could land and refuel. Just after eight o'clock on the morning of 19 June, Ozawa launched his aircraft. Radar picked up the incoming attackers, which came in four waves because the nine Japanese carriers were divided into two groups, each division operating 100 miles (160 km) apart. The results were disastrous for the Imperial Japanese Navy fliers, as Task Force 58 fighters mauled them in an aerial battled quickly dubbed the 'Great Marianas Turkey Shoot'. Over 300 aircraft fell to the guns of F6F Hellcat fighters in under four hours.

Mitscher's decision

Thus the stage was set for the US Navy to turn the tables. On the morning of 20 June, Task Force 58 commenced searches to the west in hopes of locating the Japanese Fleet. Not until after 15.00 did an Avenger from VT-10 send the message everyone in the Task Force was waiting to hear: "Enemy fleet sighted." Vice Admiral Marc A. Mitscher now faced a difficult decision. The chance to destroy the Japanese once and for all was in his grasp, but it would be a risky mission for his beloved fliers. The enemy fleet lay 275 miles (443 km) away, beyond the maximum range of his aircraft, and launching a strike so late in the afternoon guaranteed that his aircraft, if they made it back, would have to land aboard their carriers after dark. The veteran aviator, who in 1919 had made his own harrowing night flight piloting a giant flying-boat across the North Atlantic as part of the Navy's attempt to make the first transatlantic flight, did not hesitate in making his decision.

Task Force 58 sent 226 aircraft against the Japanese Fleet, among which were 54 Avengers from 10 torpedo squadrons. Only the aircraft of four squadrons carried torpedoes in their bomb bays, with the rest lugging 500-lb bombs. Once airborne, the fliers were greeted with the disconcerting news that their target was 60 miles (96 km) farther west than previously thought. The aircraft droned on, west into a setting sun, with reduced chances of returning to the ships they left behind.

First sighting of the Japanese fleet came at 18.40, and the American strike group sent aircraft after three formations of Japanese ships, outlined by the brilliant hues of a Pacific sunset. Avengers met with varied success in their attacks against the Japanese. Many of the glide-bombing runs were made at steep angles that stressed the aircraft beyond their limits: the result was blown-out windshields and, in some cases, jammed bomb bay doors. Malfunctioning torpedoes, long a nemesis, made their appearance again, in a few cases exploding prematurely seemingly just before they hit the side of a Japanese ship. Nevertheless, bombs from VT-10 holed *Ryujo*'s flight deck, while eight Avengers from VT-28 and VT-31 put 500-pounders into the carrier *Chiyoda* and battleship *Haruna*.

The only aircraft in the strike group to grab the ultimate prize, a sinking, were four torpedo-armed TBFs from VT-24. The flight's leader Lieutenant (junior grade) George P. Brown spotted the carrier *Hiyo* off to port and led his tiny attack force in a sharp turn for an attack run. One pilot became separated from the others, leaving a trio of aircraft to commence an angle attack against the bow of the carrier from a distance of 5,000 ft (1524 m). Anti-

Above: An Avenger Mk I or II overflies HMS Indomitable *on 24 or 25 May 1945, the dates of strikes on Sakishima. The censor has crudely removed the ship's deck number (92).* Indomitable*'s own Avenger squadron was No. 857, although this aircraft would appear to have come from another carrier judging by the state of the deck below.*

Above: Crew members of Indefatigable *rush to the deck edge as a No. 820 Squadron Avenger sinks in the distance.*

Right: Avenger IIIs from No. 848 Squadron on Formidable *set out to bomb a Japanese kamikaze base. Like many other Pacific Fleet Avengers, they have ventral guns fitted.*

A TBM-1D of future President George Bush's squadron, VT-51 from* San Jacinto *(CVL-30), patrols the Marianas, 1944.

Far right: Like most 'Iron Works' products, the Avenger was a tough old bird. This VT-83 TBM-3 made it to a safe ditching despite the loss of most of its tail feathers over Okinawa.

aircraft fire set Brown's aircraft afire, causing heavy smoke in the fuselage that prompted his two crewmen to bail out. However, the intrepid pilot pressed on, boring in for an attack and, after releasing his torpedo, flying the entire length of the flight deck in an effort to draw fire away from his squadronmates. Lieutenant (junior grade)s Benjamin Tate and Warren Omark followed their leader. "I knew I had a good shot at the carrier," the latter remembered. "I started to jink pretty good. [I] pulled up and came over the flight deck and made a pretty sharp left turn to allow the turret gunner to strafe. Then I went down on the water again." Tate had a close call following his torpedo run as a round took the top off the control stick in the cockpit. In addition, both his wing and turret guns were knocked out by enemy fire. It seems that at least two and possibly all three torpedoes found their mark, and just two hours later *Hiyo* slipped beneath the waves. Both Omark and Tate had to fight their way out. Omark's gunner drove off three attackers, while Tate bluffed his two tormentors by turning into them as they made their runs.

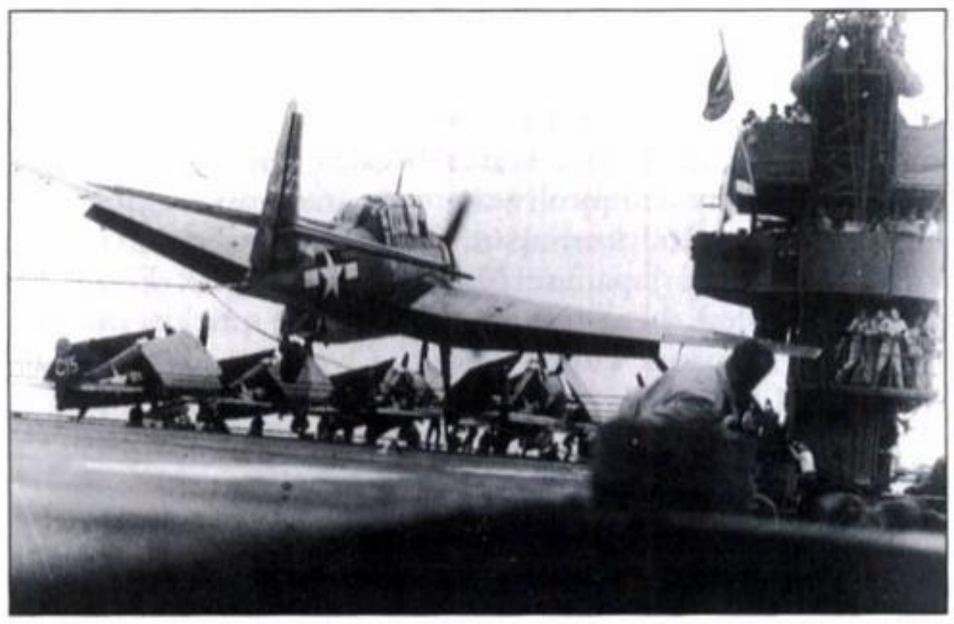
A ditched Avenger was estimated to stay afloat for two minutes at best, although this was much longer than many other aircraft. This TBM-1 (BuNo. 06258 of VT-24) crashed on take-off from USS* Belleau Wood *(CVL-24). The pilot clambers from his cockpit while the gunner exits from the side of his turret. The most vulnerable crewman in a ditching was the radioman, whose entry/escape hatch can here be seen opening.

Defensive formations

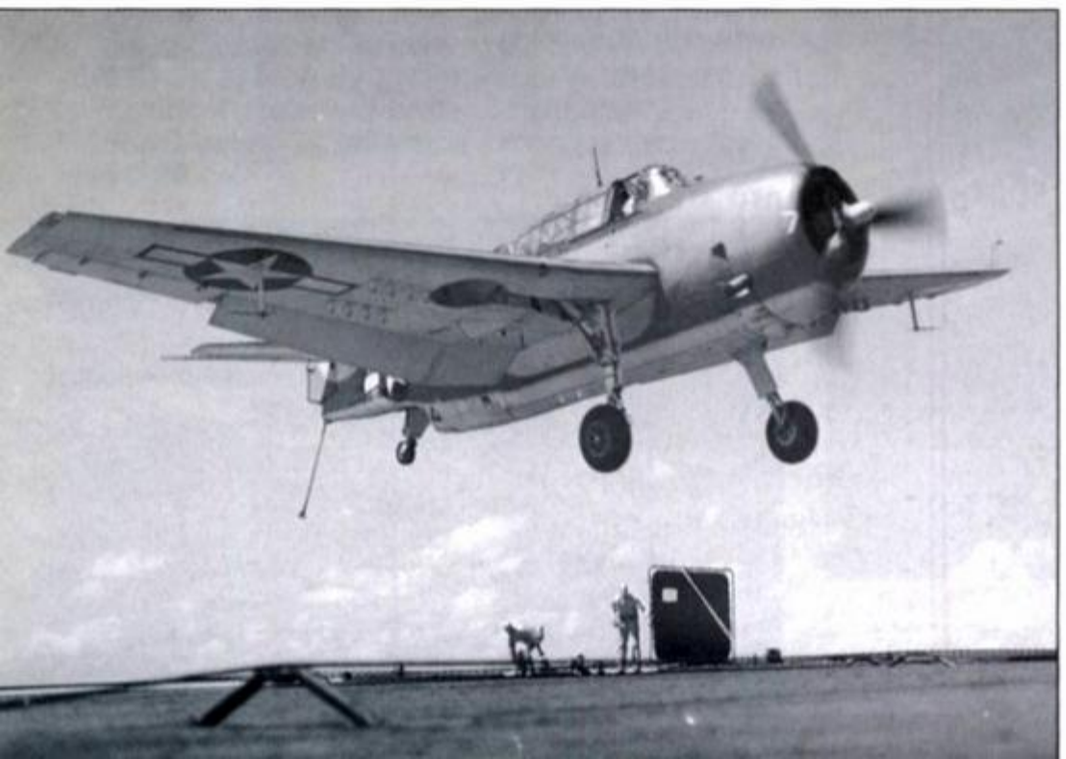
The VT-24 pilots were not the only 'torpeckers' to endure attacks by enemy aircraft over the Japanese Fleet. As an example, the action report of VT-16 off *Lexington* records seven attacks by 'Zekes' against the squadron's aircraft, most of which were driven off by turret gunners. The defensive tactic of choice was remaining in tight formation and holding fire until the enemy aircraft were in range. Often, the attackers would pull out of their runs below the formation, presenting a good target. One VT-16 aircraft did fall to enemy fighters. Lieutenant (junior grade) Warren E. McClellan had no sooner heard the radio call that enemy fighters were attacking when about 50 tracers "appeared to pass through my aircraft ... I pulled back quickly on the stick to avoid other possible bursts, but a fire started in the cockpit on the port side. The cockpit was ablaze before I could find the microphone; however, the crewmen fortunately realised the gravity of our situation and were ready to parachute almost as soon as I." Like George Gay at Midway, the three fliers, as well as the two crewmen who had bailed out of Brown's aircraft, had a grandstand seat for the attack. All were rescued the following day.

The survivors of the attack found the return flight to Task Force 58 just as harrowing. With gradually emptying fuel tanks, they plodded through the gathering darkness,

The pilot and radioman have made it clear from the wreck of VC-21 TBM-1C BuNo. 46203, which crashed off USS* Marcus Island *(CVE-77) in March 1944.

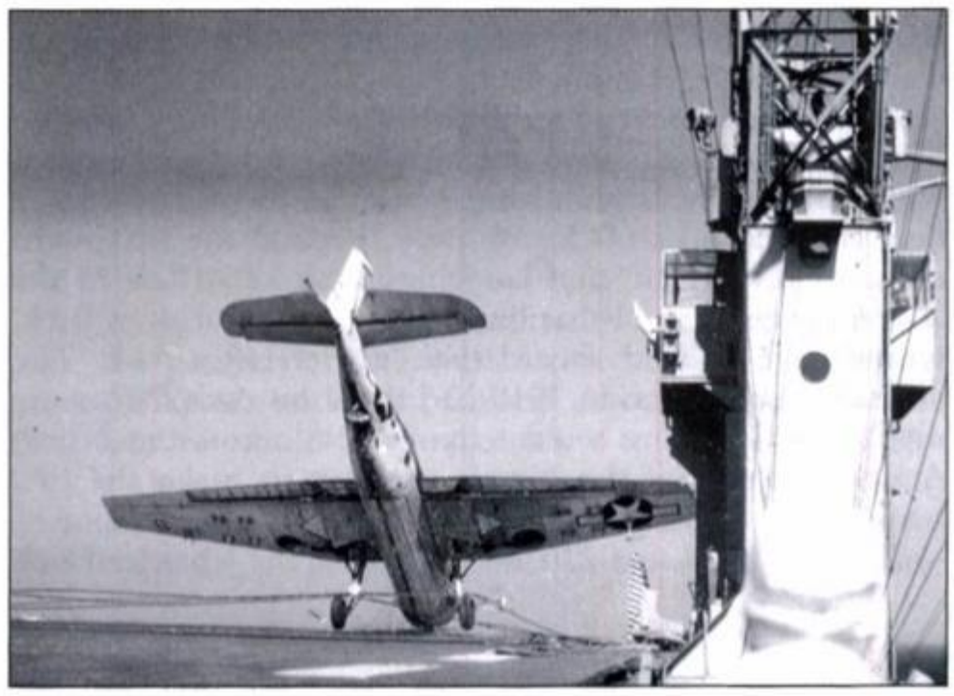


Far right: Observers on the 'vulture's row' of USS* Chenango *(CVE-28) flinch as a VT-25 TBM-3E drifts towards the island, unrestrained by its 'stinger'-type hook, March 1945.



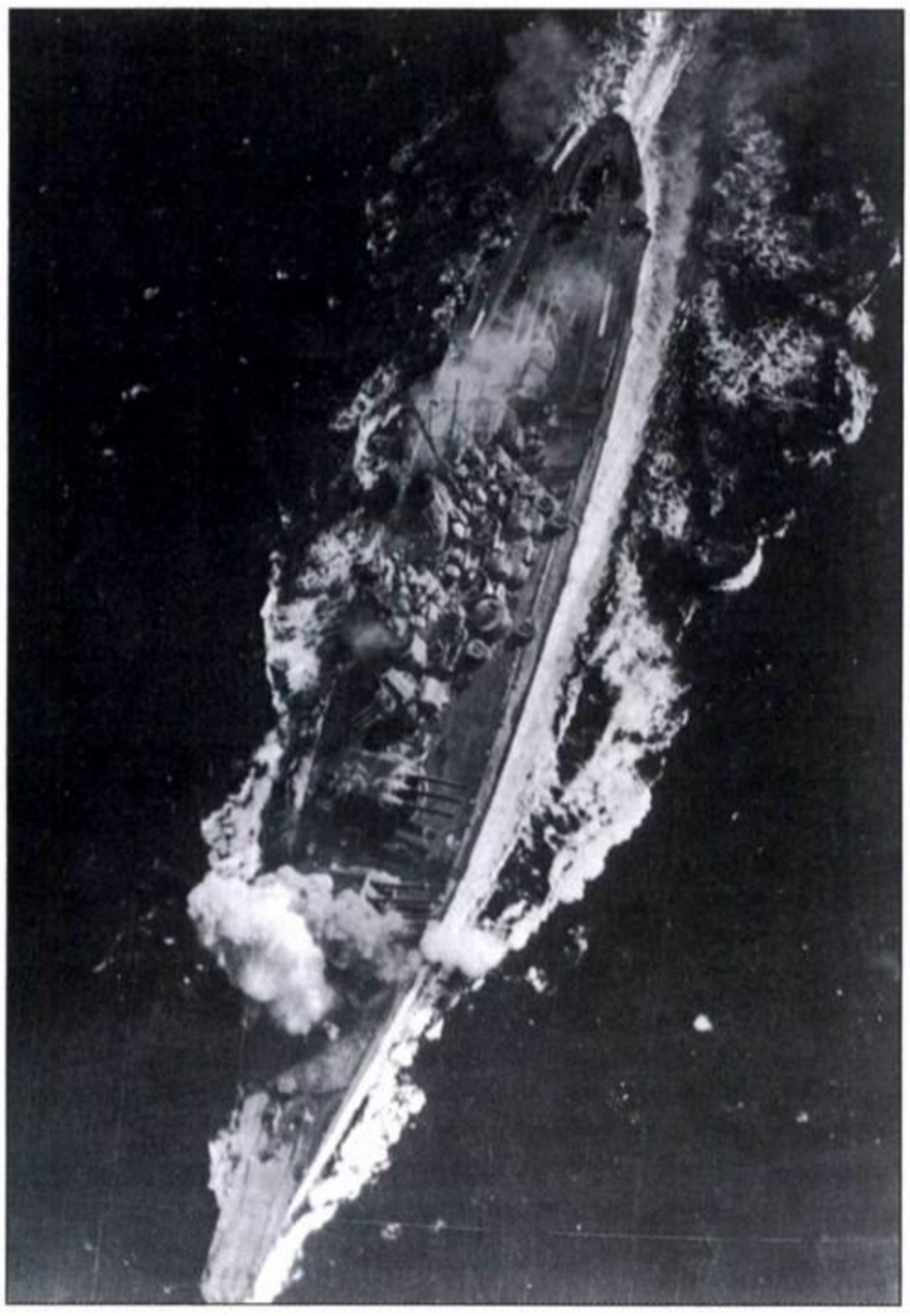
Left: A TBM is waved off from USS* Makin Island *(CVE-93), one of the 'Casablanca'-class escort carriers, 17 March 1945. Longer than the 'Bogue'-class, the 'Kaiser Carriers' were 6.5 ft (1.97 m) narrower across the deck.

Right: This aircraft came to grief on the 'Independence'-class carrier USS* San Jacinto *(CVL-30) on 18 February 1945.



TBM vs IJN

Although it was the Douglas Dauntless that broke the back of the Imperial Japanese Navy's carrier force in the early years of the war, carrier-based Avengers were instrumental in the destruction of a great proportion of the IJN's major surface combatants in the latter half of the war. Capital ships sunk by VT squadrons alone or in conjunction with other units included the carriers *Ryujo, Hiyo, Zuiho and Zuikaku* and the superbattleships *Yamato* and *Mushashi.*



A bomb hits on the forward deck of* Yamato*, the largest battleship ever built, 7 April 1945. The ship's forward 18-in main guns were aimed at the approaching Avengers to form a splash barrage, but 10 torpedo hits were made and the mighty warship sank with over 2,000 of its crew.

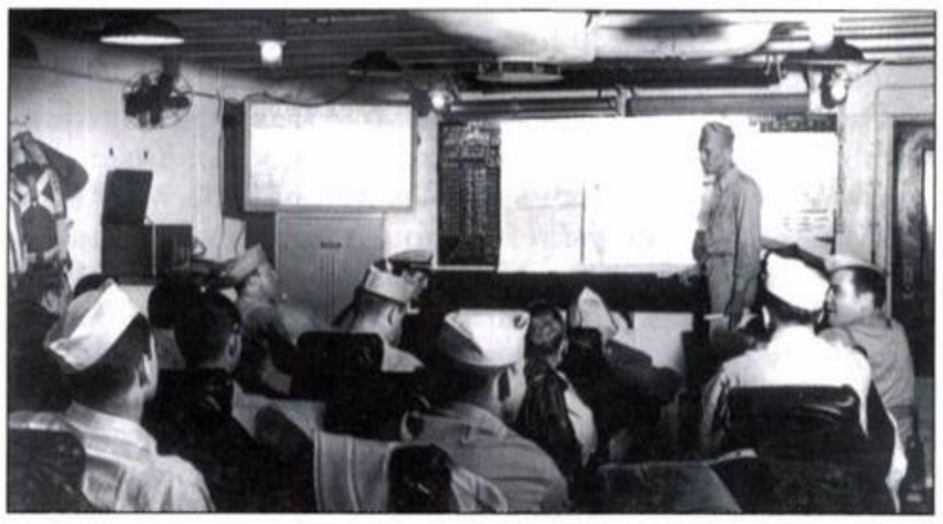
fighting vertigo and weariness. Warren Omark came alongside Brown's aircraft, which was charred from the fire and had one bomb bay door stuck in the open position. With the canopy open, Omark could see blood all over the arm of his squadronmate. Although Brown held formation for a while, he eventually disappeared in the dark, never to be seen again. Aboard the carriers of Task Force 58, blips began to appear on radar screens at 20.15 and, as they drew nearer, the order was given to "turn on the lights," a potentially dangerous situation in waters where enemy submarines might be prowling. As search lights crisscrossed the sky like a Hollywood premier, pilots aimed for the first lighted deck they could find, creating an atmosphere that resembled a New York City street during rush hour as pilots cut one another out of landings and ignored wave-offs. After being guided back to the fleet by a night-fighter, Omark set his sights on USS *Lexington*. "I was turning into the groove and a guy who ... wasn't anywhere near the groove tried to cut me out. Everybody was anxious to get aboard, I tell you ... Very fortunately I had started to push off to starboard to make another circle and he got a wave-off. And boy, I slipped right back in. I saw the wands; I saw the cut and boom! I was never so happy in all my life. But it wasn't ... the prettiest carrier approach." After landing,

Above: A Japanese destroyer breaks in half following attack by Avengers off Truk. The Truk battles in February 1944 saw the first radar-guided night anti-shipping missions.

Left: Avengers of VT-51 from* San Jacinto *set off magazine explosions in this destroyer during the Second Battle of the Philippine Sea, 25 October 1944.

the first thing the young pilot's crewmen did was kiss the flight deck.

While their brethren in the Atlantic hunted U-boats, the escort carriers on the other side of the globe engaged in the support of the island-hopping campaign across the Pacific. Their first use *en masse* came in the invasion of the Gilbert Islands in November 1943, when six CVEs launched air support missions against the Japanese garrisons on Tarawa and Makin. The action report for VC-21 off USS *Marcus Island* (CVE-77) for the invasions of Peleliu and Anguar reveals the nature of Avenger flights in support of the ground troops. During 12 straight days of combat operations, each torpedo pilot logged 49 flight hours. Missions fell into many categories, including anti-submarine patrol, photographic reconnaissance, and direct close air support



Below: LCdr John Phillips, commanding officer of VT-6 aboard USS* Enterprise *(CV-6) in 1943, and the first man in naval aviation history to shoot down an aircraft at night, flying a TBF-1 on 25 November in the Gilbert Islands.

Left: In a scene repeated in many a carrier ready room during World War II, VT-6 fliers receive a briefing aboard USS* Intrepid *(CV-11) prior to launching on a combat mission, 1944.

A Navy photographer captured this VT-83 turret gunner during a flight from USS* Essex *(CV-9). The gun breech was to the gunner's left and the gun was fired by a trigger grip mounted under the armoured windscreen. Oxygen and intercom (throat mike) leads can be seen here.

A pair of VMTB-233 Avengers flies over the West coast of Okinawa, 20 May 1945. Note Kadena airfield in the background. The rear aircraft carries the identification symbol for the second Block Island *(CVE-106), one of five escort carriers to equip with all-Marine air wings.*

Okinawa

Okinawa, the last stepping stone before the Japanese home islands, was the Marines' battle, and Marine air power was at the forefront. Once airfields had been secured in early April 1945, land-based Corsairs flew most of the close air support sorties needed, but on 10 and 17 May, respectively, *Block Island* (CVE-106) with VMTB-233 and *Gilbert Islands* (CVE-107) with VMTB-143 joined the fray. VMTB-131 and VMTB-232 followed later, based on Ie Shima. The latter unit gained fame with USN TBMs in ground support missions on 20 May, flying over army troops at 15 ft (4.5m) to accurately attack enemy strongpoints.

against targets obstructing the advance of ground forces. Avengers also logged 22 sorties carrying Marine and Army air observers. Lasting up to 5.5 hours, these flights involved flying at treetop level and destroying targets of opportunity. For ordnance, TBMs carried eight rockets, which proved highly effective against tanks, fuel and ammunition dumps, and the pillboxes and caves that were so deadly to the 'grunts'. Depth charges were not only carried for anti-submarine work, but were released against land targets as well. Employed against explosive targets like fuel and ammunition dumps, the aircraft's forward-firing machine-guns could inflict great damage.

Marines on board

As the Pacific offensive moved to Okinawa, 'leather-neck' Avengers participated in their first sustained shipboard operations of the war. With its land-based aerial assets being gradually left behind by the war, the Marine Corps had long been pressing the Navy to put some of its fliers aboard ship. In October 1944 eight Marine Carrier Air Groups (MCVG) formed in California, each consisting of 30 aircraft divided into 18 fighters and 12 torpedo-bombers. The training of the pilots and aircrew placed particular emphasis on close air support.

Only two CVEs with Marine air groups saw extended combat operations. *Block Island* and *Gilbert Islands* launched missions against Okinawa in May-June 1945, with three TBMs lost to enemy fire. Although trained for close air support, aircraft from the two 'baby flat-tops' spent only 13 days flying on this particular mission, with the remainder of the flights being attacks against airfields. Navy squadrons had been supporting amphibious assaults for a long time, and the naval leadership was hesitant to transfer all close air support missions to the newly arrived Marine Corps. Nevertheless, a seed had been planted, and among the first aircraft to fly close air support missions when war broke out in Korea were Marine fighter squadrons operating from escort carriers.

The greatest sea battle

Escort carriers did get one opportunity to engage in a traditional ship vs ship engagement during the war. In October 1944 the Imperial Japanese Navy put to sea for the last time in hopes of meeting in a decisive sea battle. Their plan was a complicated one. With their carrier-based aircraft decimated at the Battle of the Philippine Sea, it called for six carriers, two of which were battleships outfitted with flight decks, to operate north of the Philippines in hopes of luring the large-deck carriers of the US Third Fleet, under command of Admiral Halsey, away from the vicinity of the islands. Meanwhile, powerful Japanese surface forces, one of which included the giant battleships *Musashi* and *Yamato*,

A VMTB-232 TBM-3E drops 500-lb bombs on Japanese positions on Okinawa. This aircraft also fired HVAR rockets on the same target, demonstrating the Avenger's versatility.

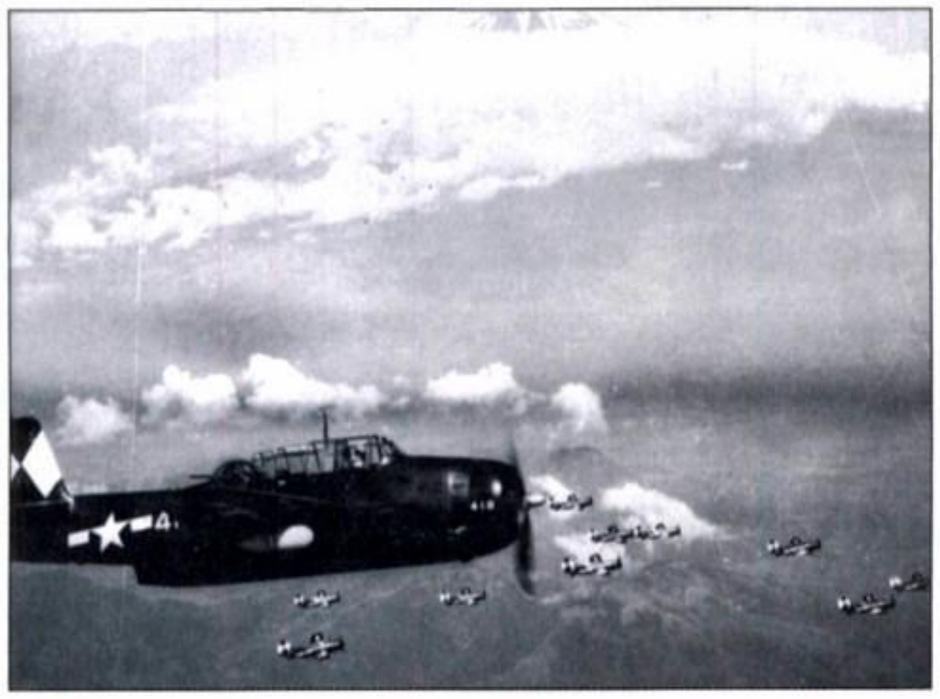
In addition to bombs and rockets, the Avenger was cleared to drop less deadly cargo. Here, a load of food, water and ammunition is parachuted to the First Marine Regiment, cut off from their supplies by muddy roads at Shuri Castle.

were to thread their way through the San Bernadino Strait and descend on the transports unloading troops off Leyte.

The Japanese plan ran into trouble from the beginning when, in the early morning of 23 October, the powerful Centre Force of surface ships under the command of Vice Admiral Takeo Kurita was spotted by two US submarines, which staged night torpedo attacks that sunk two cruisers and damaged another so severely that it had to turn back. The next day aircraft from Halsey's carriers pounded Kurita's ships, launching five strikes against the force, which resulted in the sinking of *Musashi* and damage to a number of other vessels. The Japanese ships manoeuvred so wildly that returning fliers reported that the force was turning back. Temporarily stung, Kurita's force did retire, but only long enough to regroup; therefore, when the Japanese carriers were detected north of Leyte, the aggressive Halsey sent his big-deck carriers after them, leaving a force of escort carriers to guard the transports.

In the early morning of 25 October, sunrise brought the sight of Kurita's still powerful Centre Force coming over

Far right: VMTB-232 crews head towards their aircraft on Okinawa prior to launching on a combat hop, 4 May 1945.



the horizon. The first to see the ships was the crew of a VC-20 TBM-1C off *Kadashan Bay*. After dropping a depth charge against a cruiser, Ensign Hans L. Jensen headed for a cloud bank, where two anti-aircraft shells hit close enough to buffet his aircraft. He then observed a Japanese 'Pete' floatplane launch from a Japanese battleship, and when it had reached a position just below him he dove his torpedo-aircraft like a fighter, his wing machine-guns blazing. He soon found himself inverted over the aircraft, which allowed his turret gunner to blaze away at the enemy aircraft. Although they did not shoot it down, Jensen and his crew had fired the first shots of what would be an eventful day.

Battle begins

The first bellowing of guns came from *Yamato*, the mightiest battleship afloat, just before 07.00, and the remainder of the Japanese ships soon followed. The Japanese used dye markers to spot the fall of their shells, and soon the escort carriers of Taffy 3, the group closest to Kurita, were bracketed by brilliantly coloured geysers.

Aboard *Kitkun Bay*, the sounding of 'Flight Quarters' interrupted breakfast and the fliers were told that the Japanese fleet was 14 miles (23 km) astern. Noted the squadron history, "Never in the history of any ready room was so much flight gear put on so quickly and more aircraft manned in a greater hurry." Similar scenes occurred on all of the carriers of Taffy 3. As the Japanese pursued, the Americans managed to launch 95 aircraft against the incoming ships, including 42 Avengers in various states of armament, including three with no ordnance and one with only loaded machine-guns. The scene over Leyte Gulf was unforgettable. With no time for co-ordinated attacks, the aircraft from Taffy 3 approached the ships singly or in pairs,

nipping at Kurita's flanks. Anti-aircraft fire was intense, with coloured tracers and puffs of black smoke marking the sky, occasionally finding their mark and sending an attacker down in flames. Pilots without ammunition made dummy runs, hoping to draw fire away from the aircraft carrying ordnance and to keep the Japanese from concentrating fire against the thin-skinned jeep carriers. Depending on their ordnance, Avengers either skimmed the waves to launch torpedoes or plummeted downward to drop bombs or depth charges. Few escaped without sections of the aircraft suffering jagged holes from enemy fire.

The determination of the fliers, along with the heroic efforts of Taffy 3's escorting destroyers, miraculously saved the day, blunting Kurita's superior surface force and prompting him to turn back. Even as the Japanese retired, the escort carriers kept after them, making attacks through the following day. Among the pilots launched after the Japanese began to retire was Tom Andrews of VC-5. With his aircraft on the hangar deck when *Kitkun Bay* launched it initial strike, Andrews had been left behind and spent the better part of the morning enduring the Japanese bombardment. Launched with the order to attack the ship that was the greatest threat to the force, he led his flight of torpedo-armed TBMs against a 'Tone'-class cruiser turning in circles near a crippled battleship. "I don't think they really saw us until we levelled out," he recalled. "About the time I was to make my drop ... we had tracers coming all around us ... I have to give credit to my radioman ... When I opened the bomb bay doors, he [said], 'Sir, arm the torpedo!' Oh man, if I had made that attack and not armed that torpedo!" Andrews was rewarded with the telltale geyser against the side of the ship, the mark of a torpedo hit.

All told, torpedo aircraft from escort carriers logged 254 sorties against the Japanese Fleet. In a fight in which the odds were stacked against them, the unheralded jeep carriers and their aircraft had stood fast. It was their finest hour.

Curtain call

As American forces invaded Okinawa – on the very doorstep of the Japanese home islands – the kamikaze effort reached its zenith. In the waters off the embattled island, the US Navy suffered its greatest losses of the war. On 6 April, in order to draw the carrier aircraft of Task Force 58 away from the skies over Okinawa and open the way for a mass kamikaze attack, the giant battleship *Yamato* and nine escorts sortied from Tokuyama Oil Depot and set course for Okinawa. If the dreadnought survived the inevitable airborne attacks by American carrier aircraft, the plan was

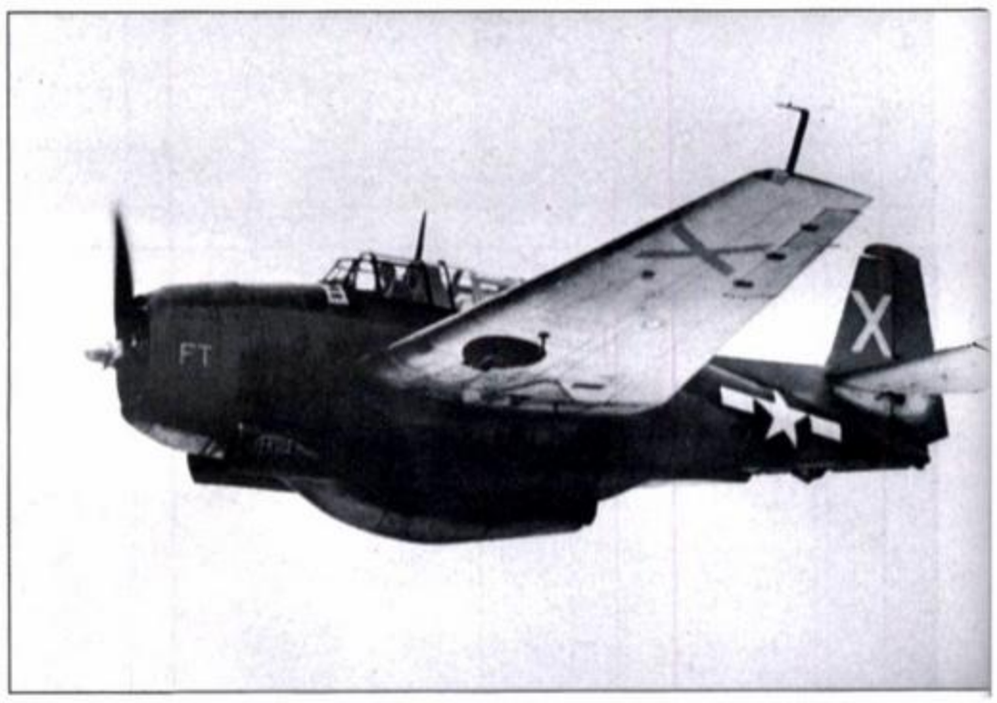
By the final months of the war, a new role had developed for the Avenger, quite different to that envisaged by its designers: formation bombing of fixed targets such as naval yards. This was made possible by the near total air superiority that had been achieved over Japan by mid-1945. These three pictures show* Essex *air group TBM-3Es and SB2C Helldivers over Japan after February 1945. The letter tailcode system was introduced on 27 July 1945, although not all air groups had adopted it by the end of the war.

Wearing the late-war carrier identification markings ('G' symbols) of USS* Essex*, this VT-4 Avenger faces stormy seas on take-off, 22 February 1945.

A VT-6 TBM-3 flies low over the Pacific en route to a target, 1945. Note the dice nose art, which was rare for Navy aircraft.

Left: This TBM-3E (BuNo. 69465) was modified with a single-seat blown canopy and a faired-over ventral position in 1946. The earlier FTBF-1 was broadly similar in appearance but less refined.

Right: **Fertile Myrtle** *was the XTBF-3 modified as a jet-engine testbed carrying the Halford H-1B in a modified bomb bay. The engine had dual intakes.*



Oddball Avengers

Left: As part of radar experiments conducted at NAMC Philadelphia in 1944, a TBF-1D (BuNo. 01733) had its AN/APS-3 radar relocated above the cockpit. This is likely to have improved the lateral trim characteristics, but probably at the expense of the pilot's health. Note the former location of the radar on the starboard wing and the extended tailwheel.

Under Project Yehudi (named after a contemporary magician), a TBF-1 and several TBM-3Ds were modified with bright lights around the cowl and wing leading edges in an early 'stealth' experiment. The basic concept was that bright light would eliminate shadow and reduce contrast, thus rendering an approaching aircraft less visible against a bright sky. The system appears to have been reasonably effective, but the project was ended in 1945 before a full evaluation could take place.

to beach it on the island and incorporate its massive batteries in the defence.

The first reports indicating that the Japanese fleet had put to sea came from a submarine on the evening of 6 April. Admiral Mitscher wasted little time in ordering one carrier task group to steam north to join two others already operating in the area. Aboard *Yorktown*, the air officer sent a three-word message down to the ready room of VT-9: "Load with torpedoes." It was greeted with resounding cheers, for the VT-9 fliers had thus far spent much of their war making glide-bombing attacks against targets ashore. Similar scenes were repeated in carriers throughout the fleet, as the 'torpeckers' were finally getting an opportunity to practise the art for which they had so long trained, i.e., launching torpedoes against ships at sea. It was one they would make the most of.

Attacking the Fleet

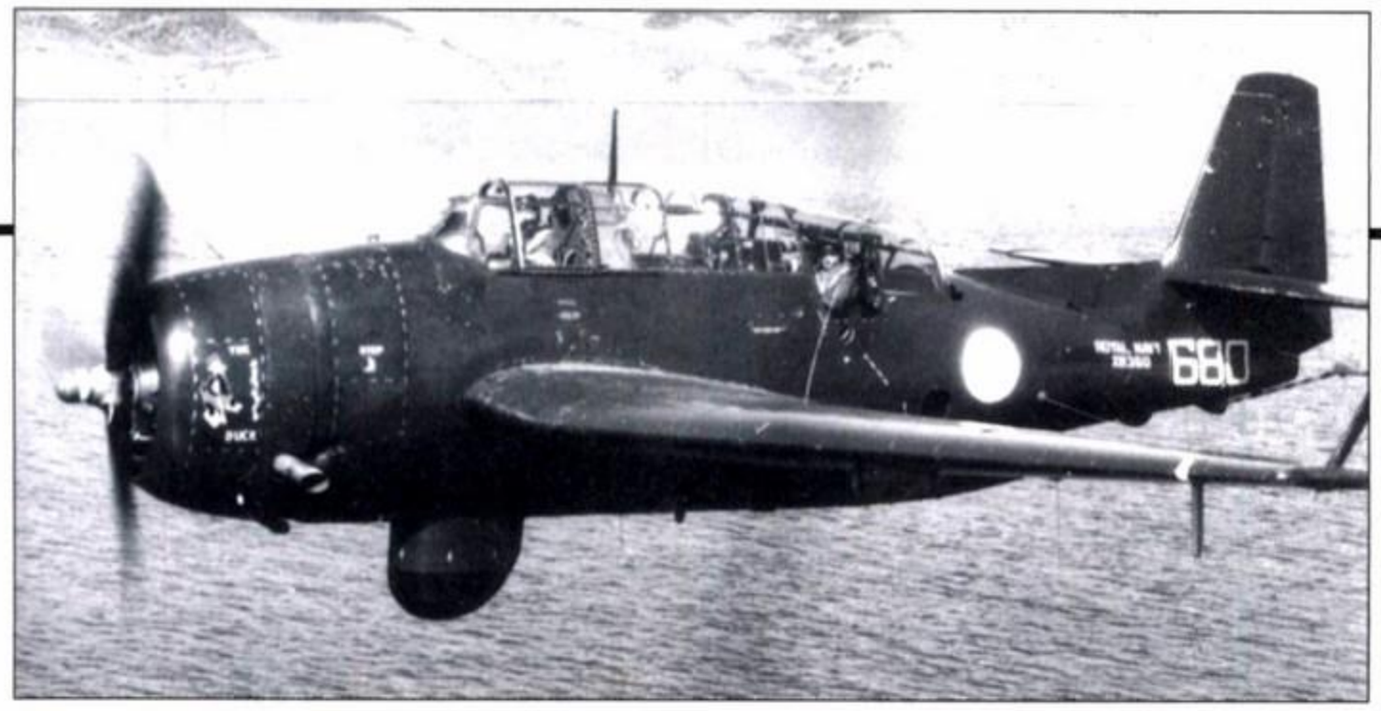
In the mid-morning of 7 April, 11 carriers turned into the wind to launch aircraft, sending nearly 400 aircraft aloft. Among the pilots taking off from the light carrier *Cabot* (CVL-28) was Bill Anderson, whose squadron had undergone a redesignation to VT-29 and transferred from the Atlantic. "Everybody was anxious to get a shot at the fleet. We were a little revved up." Mother Nature did not provide the best of days for the fliers. Remembered Anderson, "It was a pretty good haul to where it [Japanese Fleet] was ... The weather was mediocre, a lot of low clouds, a lot of rain showers. There were so many airplanes in the air, all you needed to do was keep going where the mass was going."

Among the first groups of Avengers to find the fleet were 14 TBM-3s of VT-17 from the carrier *Hornet* (CV-12), each lugging a Mk XIII torpedo. After a flight of 263 miles (423 km), the fliers spotted the Japanese Fleet at 12.40 and made one orbit around the formation before making their attack. To ensure that their 'fish' hit well below *Yamato*'s armour belt, eight of the pilots had their crewmen reset the depth settings of their torpedoes to 20 ft (6 m) before making their runs. Eight VT-17 Avengers went after *Yamato*, attacking the port side of the mighty ship, which was making good speed and throwing up intense anti-aircraft fire that burst in coloured puffs all around the attacking aircraft. Projectiles holed wings and ailerons and shattered electrical wiring systems. Boring in at 280 kt (322 mph; 518 km/h) at altitudes as low as 600 ft (183 m), the eight Avengers dropped their weapons, their pilots then jinking intensely to avoid enemy fire. One aircraft did not make it, splashing into the water just off the bow of *Yamato*. Of the eight torpedoes, VT-17 fliers claimed that four slammed into the side of the battleship, the first of many stings it would receive from the swarm of aircraft that descended on it in the coming hours.

As more attack waves arrived, the Japanese ships broke formation, each manoeuvring wildly to avoid getting hit. So many American aircraft arrived over the fleet at the same time that, according to Anderson, "it was almost as much a problem staying out of other flights' way as it was staying out of the way of the anti-aircraft [fire]." *Yamato* was pummelled with bomb and torpedo hits, the last from six Avengers of VT-9 from the carrier *Yorktown* (CV-10). At 14.23, the mammoth battleship rolled over on it side and erupted in flames that sent black smoke thousands of feet into the air, the funeral pyre for the once-proud dreadnought. Avengers had planted at least 10 torpedoes in its side, and also helped to sink five of it escorts.

There was much rejoicing in the ready rooms aboard Task Force 58 carriers that day. Sitting in his sea cabin off the bridge, the *Hornet*'s captain took a moment to write to his wife. A naval aviator since 1921, he had spent his career

Far right: TBM-3Es of VA-35 line up on the dock, waiting their turn to be hoisted aboard USS **Leyte** *(CV-32) at NAS Quonset Point, Rhode Island, 28 April 1949.*



The Ruptured Duck *was an Avenger AS.Mk 6 of No. 751 Squadron's 'B' Flight. The squadron performed electronic warfare trials and training duties from Watton, attached to the Central Signals Establishment.*

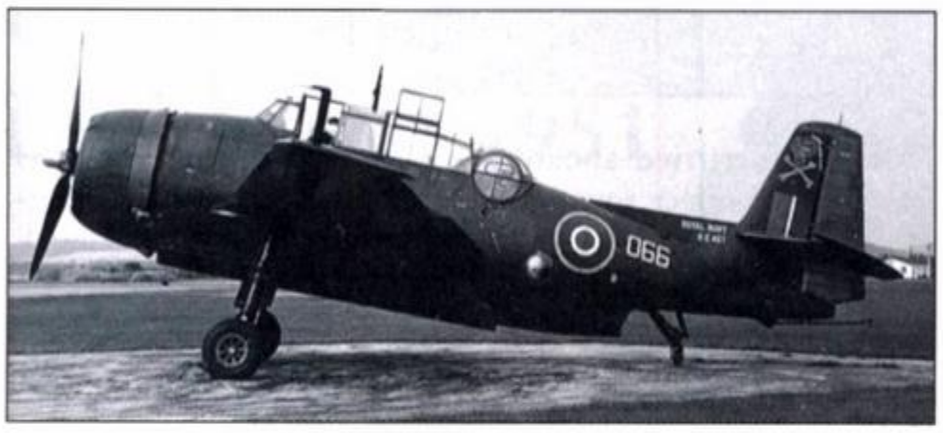
An AS.Mk 5 of No. 1844 Squadron prepares to go flying with RCN Trackers. This unit was a Royal Navy Volunteer Reserve unit, part of the Midland Air Division at Bramcote.

Post-war FAA

Under Lend-Lease rules, Britain was required to return, destroy or pay for US-supplied military aircraft. Having thus scrapped or dumped most of its Avengers, Britain acquired 100 TBM-3s under the Mutual Defense Assistance Program in 1953, partly as a stop-gap during development troubles with the Gannet. The last TBM-3s were in service as trials airframes as late as 1962.

Above left : No. 745 Squadron was re-established in April 1956 as a radar jamming trials unit with four Avenger TS.Mk 5s fitted with Orange Harvest electronic support measures (ESM) equipment. 'GN' was the code for RNAS Eglinton.

Above: One of the last MDAP Avengers, TBM-3E XB444, flies over its base at Ford, West Sussex ('FD' tailcode). In the early 1950s the primary tenant at Ford was No. 703 Squadron, to which this aircraft belonged. The squadron acted as the Service Trials Unit for the Fleet Air Arm, operating a miscellany of aircraft on a wide variety of trials duties. Several Avenger versions passed through the squadron's hands. In 1955 the unit joined with No. 771 to form No. 700 Squadron, performing broadly similar tasks to No. 703.



Like wartime Tarpons and Avengers, post-war FAA TBMs had the bulged rear compartment window. This TBM-3E was on the strength of Ford-based No. 703 Squadron.

amid the pre-war debates between airmen and surface sailors about the effectiveness of their respective weapons. This was definitely in his thoughts as he penned the words, "We've won a great victory today, and I feel very proud of the ship for ... we got the first group over the enemy fleet and delivered the first damaging blows [credit for this actually went to *Bennington* fliers]. It was a great achievement and poetic justice ..."

The era of the battleship as the dominant force at sea was over.

Fleet Air Arm Avengers

The foreign user to make most use of the Avenger was the Fleet Air Arm, which began receiving the big torpedo-bomber under the auspices of Lend-Lease in 1943. Initially calling the aircraft Tarpon, the British reverted to the American name in 1944. All told, the Fleet Air Arm received 402 Avenger Mk Is (equivalent to TBF-1), 334 Avenger Mk IIs (equivalent to TBM-1), and 222 Avenger Mk IIIs (equivalent of TBM-3 and -3E). During the course of the war, the aircraft outfitted 15 Royal Navy squadrons, whose crews familiarised themselves with their new aircraft at NAS Norfolk, Virginia, or NAS Quonset Point, Rhode Island, before entering operational service. As the war progressed, some British pilots followed the same training route as US naval aviators, receiving intermediate training at NAS Pensacola, Florida, and operational training in torpedo-bombers at Ft Lauderdale, Florida, before joining their squadrons on the East Coast.

Like American pilots, those of the Fleet Air Arm quickly appreciated the ruggedness and reliability of the big torpedo-bomber – which did not come without a price, as evidenced by one pilot's recollection that "it was heavy on the controls, requiring much use of the trim controls." The Avenger proved a good aircraft around the ship, with one pilot remembering that "the controls remained positive until near the stall, of which there was ample warning, and once on the deck the Avenger 'stuck,' partly due to its weight and partly to its excellent oleos." This was especially comforting to pilots operating from escort carriers in the stormy North Atlantic, as was the modification to some Fleet Air Arm Avengers to enable messages – and, more importantly, hot drinks – to be passed between pilot and crewman through an opening in the bulkhead of the front cockpit.

No. 832 Squadron became the first squadron to receive Avengers, taking delivery of 15 at Norfolk on New Year's Day 1943, and heading to the Pacific. In April 1943 the squadron went aboard USS *Saratoga* (CV-3), becoming the first Fleet Air Arm unit to fly combat missions from the deck of an American carrier. The following year, the venerable US Navy flat-top would join HMS *Illustrious* in staging a joint strike on the Japanese naval base at Surabaya, Java, which marked the first major strike of the war by Fleet Air Arm Avengers. Having replaced the short-legged Fairey Barracudas aboard *Illustrious*, Avengers of Nos 832

Left: This gaggle of TBM-3Ws and -3Es is from VS-32 on USS Cabot (CVL-28).

Right: A VC-11 TBM-3W and a VS-25 TBM-3E formate. The top speed of the 'Guppy' Avenger was noticeably less, but cruise speed was comparable.

Above: In the early days of hunter-killer operations, the ratio of TBM-3S2 'scrappers' to TBM-3W2 'skimmers' was about 2:1, as there were not enough of the latter to equip all of the squadrons. This is VS-32 aboard one of the many carriers they briefly called home, USS Cabot (CVL-28) in 1949.

Right: VS-32 ASW teams prepare for launch from Salerno Bay (CVE-110) during Caribbean exercises in March 1952. The advent of the larger AF Guardian spelled the end for the Avenger in US service and of the wartime 'jeep' carriers.

AEW/ASW Avengers

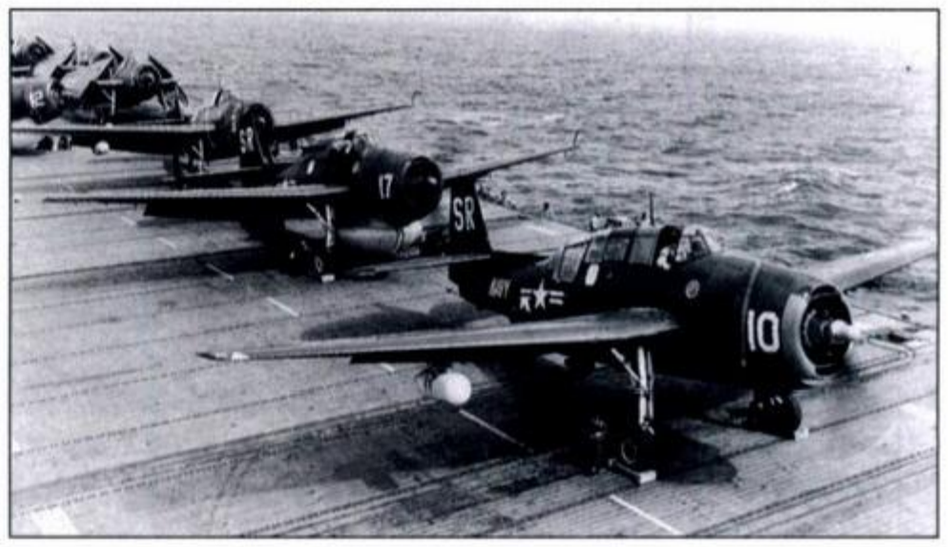
Under Project Cadillac I, initiated in early 1942, the design of a search radar for carriage by the new Avenger was initiated at the Radiation Laboratory of MIT in Boston. Great urgency surrounded this project due to the increasing threat to the Pacific Fleet from kamikaze attacks. The result was the TBM-3W with its AN/APS-20 radar designed around the dimensions of the Avenger's bomb bay, and an operator stationed in the cramped rear compartment. Armament was removed and the rear 'greenhouse' faired over. About 40 conversions were made. The TBM-3Ws were eventually replaced by AD-3W Skyraiders in the AEW role, but the externally similar TBM-3W2s continued as ASW aircraft. More than 160 were converted from TBM-3 airframes and the type was exported to France, the Netherlands, Canada and Japan.

Fairey Barracudas aboard *Illustrious*, Avengers of Nos 832 and 845 Squadrons joined the aircraft of *Saratoga*'s Air Group Twelve in Operation Transom. Escorted by F4U Corsairs, another Lend-Lease aircraft, 18 torpedo-bombers launched at 04.30 and crossed the Java coast at 14,500 ft (4420 m). The British aircraft's assigned target was the Braat Engineering Works and factory area, plus naval workshops and a floating dock in the harbour itself. Despite the fact that 13 enemy airfields fell within an 80-mile (129 km) radius of the target area, the British and American aircraft caught the enemy by surprise, inflicting heavy damage with minimal losses. Following the joint strike, Air Group Twelve's colourful commander, Commander Joseph C. 'Jumpin' Joe' Clifton, received a message from *Illustrious*. "We are very proud and pleased to have done it with you + your experienced chaps. It really has helped us to start our time out here + we learnt a lot from you all." The Fleet Air Arm had cut its teeth with regard to carrier operations in the Pacific, and opened the way for a larger-scale effort.

Refinery attacks

During the remainder of 1944 the British gathered their forces in the Pacific. In December, *Indefatigable* and *Indomitable* launched a strike against the Japanese oil refinery at Pangkalan Brandan in Sumatra, though clouds forced the aircraft to divert to secondary targets. Revisiting Pangkalan in January 1945, three carriers put 12 rocket-carrying Fireflies, 32 bomb-laden Avengers and their escorts over the target. The raiders left the refinery aflame and smoking. In the wake of this successful attack, the Royal Navy turned its attention to important targets at Palembang, Sumatra, and specifically two refineries responsible for producing the bulk of Japan's aviation fuel. Four carriers and their escorts weighed anchor at Trincomalee, Ceylon, on 16 January 1945, and set course for the waters off Sumatra. Among the

The last US military Avengers were TBM-3W2s of the Naval Reserve such as BuNo. 31454 from NAS Willow Grove, seen at NAS Dallas in May 1954. The Reserve Antisubmarine Tactical School was established at Willow Grove in 1951, but the nature of ASW training conducted in central Texas is unclear.



238 aircraft carried aboard the four flat-tops of Force 63 were five Avenger squadrons. The mission was a challenging one not only in that the target was heavily defended, but also because of the natural obstacles that confronted the airmen. Sub-Lieutenant J. F. Brown, an Avenger pilot in No. 849 Squadron aboard *Victorious*, recalled that Operation Meridian "was at that time the longest overland operation by carrier-based aircraft. Our fleet was stationed on the Indian Ocean side of Sumatra, while our target was on the opposite side of the island. In addition, there was a 10,000 ft mountain range between us and the target, which for a fully-loaded Avenger was a formidable obstacle in itself."

Force 63 sent its first strikes against Palembang on 24 January. Corsairs, Hellcats and some Seafires managed to destroy many of the defending Japanese fighters on the ground, but some managed to get airborne. Each carrying four 500-lb bombs, the Avengers packed the strike's offensive punch. Arriving over the Pladjoe refinery, they discovered that it was protected by barrage balloons that the Japanese released as the Avengers attacked. The balloon cables sliced into some aircraft as they glided down towards the target, but the majority of the aircraft made it through and planted their ordnance squarely on the target, setting the refinery ablaze and shrouding it in black smoke. After retiring for refuelling, Force 63 returned to launch a second strike on 29 January, this time against Songei Gerong, the second refinery at Palembang. The main strike consisted of 48 Avengers and their fighter escorts. Having flown in reinforcements during the days between strikes, the Japanese intercepted the strike group, whose escorting fighters could not keep all of the enemy fighters away from the bombers. However, like their counterparts in the US Navy, Fleet Air Arm Avenger crews could turn the tables on an enemy fighter. Making use of their 0.50-in wing guns, two pilots

Eastern Aircraft TBM-3W2 Avenger VS-32 USS *Palau*, 1951

Foreign operators
TBM-3W2s served with four foreign operators. Canada acquired eight in 1952, France took 30, Japan received 10 and the Netherlands acquired 24. They were principally operated with TBM-3S aircraft in the hunter/killer ASW role.

Radar
The bulbous radome fitted to the TBM-3W was constructed in two parts split lengthwise. It contained only the antenna for the AN/APS-20 set and was often left unpainted. The antenna measured 8 x 3 ft (2.44 x 0.91 m) and rotated at 6 rpm. The nominal range of the AN/APS-20 was 135 nm (250 km).

Hunter and killer
As anti-submarine (ASW) aircraft, the TBM-3W2 'hunters' operated in conjunction with TBM-3S 'killers' in prosecuting undersea contacts. The TBM-3S and -3S2 models had gun armament deleted and a searchlight added, as well as a datalink fin antenna for communicating with the carrier and the TBM-3W2. The whole system worked well – when it worked – but if one piece of equipment failed, particularly the radio, the team was out of action. Theoretically, the 'hunter' could control two 'killers', but this was not really practical as the radar operator could rarely keep track of two other aircraft *and* the target at the same time.

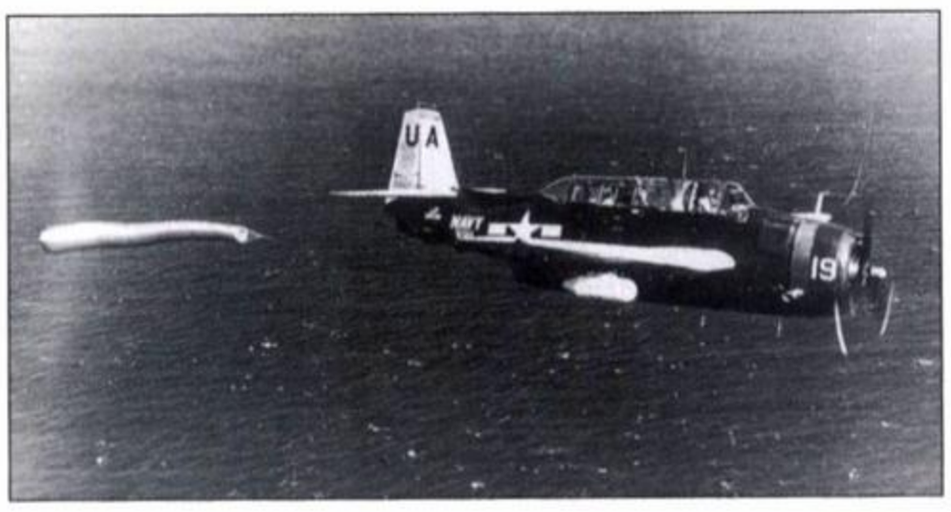
Deployment
The TBM-3W2s entered service with VS squadrons in 1950/51, replacing TBM-3Es. Their career was brief. Six reserve VS squadrons (VS-892, -20, -30, -36, -37, -39) were called to active duty in Korea and two new units (VS-26 and -27) were created. The navy was worried about the threat from up to 78 'Communist' submarines in the region and urgently sought ASW protection for its carriers. The threat never materialised and the VS units spent a lot of time ashore to make room on the carrier decks for close air support aircraft. The aircraft very rarely deployed to the same carrier twice in Korea. The last TBM-3W2s were phased out of reserve squadrons at the end of 1956, becoming the last Avengers in US military service

TBM-3W2s were conversions from existing airframes (this aircraft, BuNo. 69476, was built as a TBM-3E). Squadrons would be equipped with aircraft from a mix of production blocks, all of which might have different cockpit layouts and other differences. There were no obvious external changes between the -3W AEW version and the -3W2 ASW aircraft. The AN/APS-20 radar was adjusted for optimum performance against submarine snorkels. Some sources suggest that a second operator was shoe-horned into the rear compartment on the TBM-3W2.

AEW tactics
When used in the early-warning role, a TBM-3W would fly a barrier patrol at 30-70 miles (48-113 km) from the task force centre at an altitude of 2,000-5,000 ft (610-1524 m). The raw radar return went to Polar Plot Indicators (PPIs) at the operators' stations and then, mixed with a synchronising signal, was sent via the fin-tip relay antenna to the Combat Information Center (CIC) of the carrier or control ship. Combat air patrols were usually controlled by the CIC, but this function could be taken over by the Avenger, making them a true ancestor of today's AWACS aircraft.

This picture of VS-25 TBM-3s off San Diego on 15 March 1950 is part of a well-known series showing Avengers over ships and submarines of the Pacific Fleet. Evident in this and one other image is what appears to be a cable trailing from the near TBM's wingroot.

Right: Japanese fighters were not the only aircraft to make firing passes at the Avenger during its career. TBM-3Us began equipping Navy utility squadrons in the early 1950s and among their duties was 'towing the sleeve' for fleet fighters. Here a VU-1 bird flies off the coast of Hawaii. Note the elongated canopy common to most target-tug Avengers.



Above: In a fairly rare procedure, a pair of VR-22 TBM-3R COD aircraft makes ready for a stern launch off USS Midway (CVB-41) during LANTFLEX exercises, 1 November 1951. The TBM-3R was modified to take up to seven passengers in the rear fuselage and cargo in a basket in the bomb bay.

The TBM-3Us were the most colourful of all military Avengers, with their yellow wings and tails. This aircraft was assigned to VU-7A.

flamed a pair of Japanese fighters during the attack. As on 24 January, the Avengers made determined attacks despite the enemy defences, and successfully bombed the refinery.

The success came at great cost, as evidenced by the Aircraft Readiness Board for No. 849 Squadron, which had become separated from its fighter escorts during the attack. Of the 12 Avengers launched from *Victorious*, four were listed as missing, five were damaged by flak, and three had received damage from gun blasts.

The strikes against Palembang were a feather in the cap of the Royal Navy's carriers. Renamed Task Force 57, the British Pacific Fleet would eventually include nine flat-tops carrying 37 squadrons, seven of which flew Avengers. For the remainder of the war they joined the US Navy in launching strikes against Okinawa and the Japanese home islands, and battling the hordes of kamikazes.

In contrast to the large-scale carrier air strikes flown by their comrades in the Pacific, Avenger crews assigned to the Atlantic theatre carried out the more yeoman-like duties of patrolling for U-boats, minelaying, and occasional anti-shipping missions. Morley Wheeler's entire flying career in the Avenger was spent in the Atlantic. He recalled anti-submarine patrols "either as close escort in company with the convoy or as distant escort operating usually with small hunter-killer groups seeking out U-boats in the convoy routes as directed by Intelligence. These missions are best summed up as boring. The weather was our worst enemy." This changed on 1 April 1944, when he was flying anti-submarine patrol from an escort carrier in the North Atlantic, escorting the eastbound convoy JW 58 from Iceland. A pair of U-boats had attacked the convoy in the early morning hours without success, and aircraft were airborne at first light. Wheeler happened upon an anti-submarine pilot's dream: "I sighted my first, and only, U-boat [of the war] on the surface. It was partly submerged as I reached it but my depth charges would not release – this sometimes happened because the fixings on British depth charges did not exactly fit American bomb carriers. I made a second attack on the estimated submerged position – the depth charges dropped but the result was not known."

U-boat hunting

Another Avenger pilot was more fortunate later in the day, damaging *U-355* with rockets. The destroyer HMS *Beagle* finished the job with depth charges. The 'wolfpacks' continued to hunt JW 58 and just after dawn on 3 April a Swordfish spotted another U-boat on the surface. An Avenger of No. 846 joined the hunt and, while a Wildcat strafed the submarine's deck gunners, Lieutenant Tower dropped his depth charge, causing the boat to explode. *U-288* went to the bottom with the loss of all hands.

The laying of mines in the Norwegian fjords was part of an effort to sink German ships and close the 'leads', which would subsequently force the Kriegsmarine to operate in deep water, perfect prey for Royal Navy submarines. In addition, Avengers made attacks against shipping in Norwegian waters with some success. One pilot earned a

Post-war US Naval Reserve aircraft could be identified by an orange band around the fuselage over the national insignia. The Reserve flew bomber Avengers after the fleet had re-equipped with Skyraiders and other types. These NAS Glenview TBM-3Es have their tailwheels locked down, possibly to simplify maintenance.

Korea

Although not directly involved in combat in Korea, Avengers continued to serve with VS (anti-submarine) and VR (fleet logistics) squadrons from the carriers in Korean waters. Carrier Onboard Delivery (COD) of mail, newspapers and personnel was the primary role of the Avenger in Korea, conducted mostly by TBM-3Rs. The Marines used some of their few remaining TBMs as personnel transports and as general 'hacks', but a number were pressed into service as flying ambulances, especially during the break-out from the Chosin Reservoir in December 1950.

Above: A USMC TBM-3E sits at K-3 in the summer of 1951 alongside an OY-1 of VMO-6. The Avenger belongs to H&MS-33. Both aircraft were on front-line liaison duties.

Left: A pair of TBM-3S ASW aircraft lines up on the runway at Johnson AFB, Yokota, Japan in the spring on 1951. The lead aircraft is from VS-23 and the wingman from VS-21.

The first TBM takes off from the newly-completed Pohang airfield in Korea in 1952. Some strips in Korea were so short and rough (notably Koto-Ri) that LSOs with paddles were needed to direct Avengers in to land.

Standard attack-model Avengers were pressed into service as flying ambulances during the desperate early months of the Korean War. With some equipment stripped out, this TBM-3E of Marine Air Wing 1 could carry up to 10 wounded at a time from the rough strip at Koto-Ri. During the Chosin fighting, Marine pilot Captain Alfred McCaleb flew 76 evacuees to safety in one day.

Mention-in-Despatches for one of these missions when he helped to sink a pair of U-boat supply ships. Although enemy fighters occasionally intercepted these strikes, German defences consisted mainly of close-range shore batteries, one of which gave Morley Wheeler his baptism of fire. "On my first mine-laying operation as we approached the dropping point in formation for the disp[ersal] pattern, I noticed a vertical line of rather pretty red lights appearing and hanging lazily just ahead of my starboard wing. I was too busy to pay too much attention to this phenomena *(sic)* and only later did I realise this was tracer fire. Where ignorance is bliss!"

While the air assets arrayed to support Operation Overlord, the invasion of Normandy, were primarily aircraft of the US Army Air Forces and Royal Air Force, Fleet Air Arm Avengers also contributed on D-Day. Personnel of No. 849 Squadron arrived at their hangar one morning in May 1944 to find their torpedo-bombers adorned with broad black and white stripes, the identifying markings for Allied aircraft participating in the D-Day invasion. That day they flew to the RAF station at Perranporth, from where they logged sorties blocking the English Channel from attack by German naval forces. Other squadrons also participated in these flights, dubbed Operation Channel Stop.

Avengers in the RNZAF

Located along the line of communication between the United States and Australia, New Zealand played a vital role combating Japanese forces in the South Pacific. Under Lend-Lease, the Royal New Zealand Air Force (RNZAF) received 48 TBF-1/1C Avengers in the autumn of 1943, equipping Nos 30 and No 31 Squadrons. Operating from bases in the Solomon Islands, these units joined other Allied aircraft in bombing raids, as well as performing the unique mission of destroying the food supply of Japanese garrisons by spraying diesel fuel on gardens. Ironically, three Avengers that remained in the inventory following the war (more than half of the original allotment were sent to the United Kingdom or returned to the United States) participated in a project that was of great benefit to New Zealand agriculture. In trials taking place in 1948, the aircraft successfully demonstrated the viability of aerial topdressing of farmland.

The men behind the machine

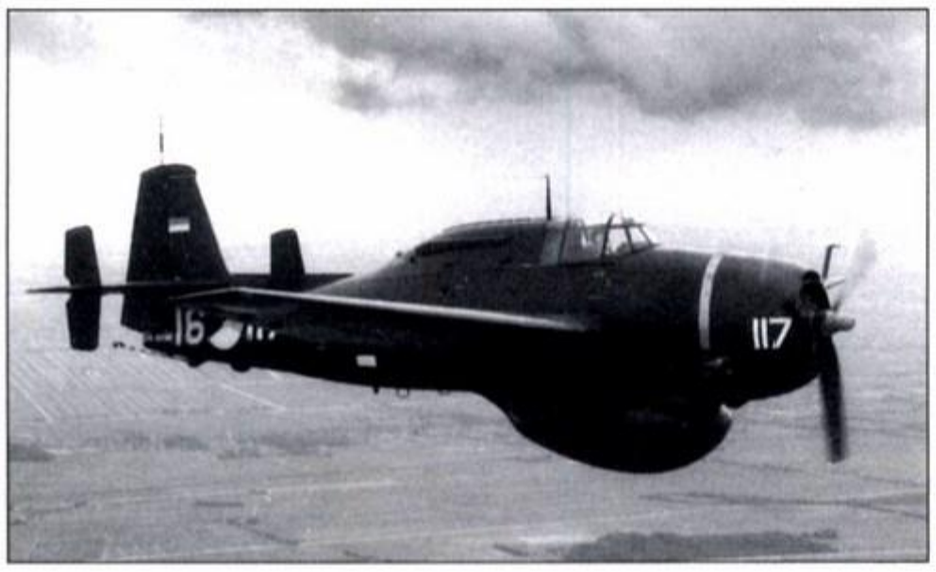
Avenger crews had differing experiences during their time flying the aircraft, though some generalisations can be made in providing an overview of what it was like to be a US Navy torpedo-bomber pilot or aircrewman during World War II. Pilots joined their squadrons with over 300 hours in their logbooks, including operational training in the Avenger at NAS Ft Lauderdale, Florida. Future President of the United States George Bush spent the months of June and July 1943 at the south Florida base, logging 30 flights in the aircraft, including nine practice torpedo runs and four bombing flights. Further instruction followed once he joined a front-line squadron, and when VT-51 entered combat aboard USS *San Jacinto* in May 1944, the future politician had nearly 700 hours of flight time. Aircrewman received aerial gunnery training at Hollywood, Florida,

Below left: Mail, the cargo that endeared COD aircraft to Task Force 77 carrier personnel operating in the waters off Korea, is packed into the cargo bin of a TBM-3R of VR-23 at K-3, 19 July 1953.

Below: Although this picture could date from World War II or come from any of the five nations that operated the Avenger from carriers, it in fact shows the 9,000th landing aboard USS Rendova (CVE-114) on 20 November 1951 in Korean waters. The TBM came from VS-892.

Above: In 1957 this TBM-3S belonged to Escadrille 5S, one of the support and training units of the Aéronavale.

Dutch TBM-3S2s prepare for a flight from Valkenberg. The nearest and farthest aircraft in line were lost in accidents – A-9 in Bermuda in and A-14 off* Karel Doorman *– in 1959.



Right: TBM-3W2 P-117 (BuNo. 91423) served with the Dutch Navy (MLD) from late September 1953 to January 1961, when it was scrapped. It was operated by 4 and then 2 Squadron, based at Valkenburg.

logging time in turrets on a range set up along the beach, skeet shooting, and firing at a target erected atop a railroad car that simulated a moving target when it ran along the track. Radioman and radar operators received their training at the Navy's technical schools located in Memphis, Tennessee.

Although they flew torpedo-bombers, as the war progressed Avenger pilots rarely dropped a torpedo in combat. VT-29 pilot Bill Anderson's logbook lists six months of combat flights, and on only two of them did he carry a torpedo. Most combat flights were glide-bombing attacks against land targets, particularly airfields. On these missions, the greatest threat was enemy anti-aircraft fire, for such was the overwhelming superiority of US fighters that only 20 Avengers fell to the guns of enemy aircraft during the period 1943-1945.

William R. Thurston remembers his first combat flight, an attack against Marcus Island in August 1943. "We were so scared that it was a perfect take-off, rendezvous, and flight to the target." Following his flight leader in a steep turn for his attack run, the VT-5 pilot found himself "upside down at 1,500 ft ... with flak coming up to greet me. Rolling out, I climbed back and made a proper run on the target, rather fascinated by the 'meatballs' of flak aimed at me." These 'meatballs' could prove deadly, as George Bush discovered over Chichi Jima. With his engine in flames after being hit, the future president barely made it out of his smoking aircraft, knocking his head on his Avenger's tail as his parachute opened. He drifted alone in his raft for two hours, feeling like it was "the end of the world," before being rescued by a submarine.

The diary of a VT-30 aircrewman from USS *Belleau Wood* offers a poignant look at combat. "One of our radioman was killed ... A 40-mm shell entered the radio compartment at the door + exploded right next to him, perforating the whole port side of the radio compartment. Parkers *(sic)* fatal wound was in the side of his neck ... Goodbye to another of our shipmates, who was perhaps a little bit afraid when he took off but still had the guts to go through with it. All of us are afraid when it comes to this."

In the inherently risky business of carrier operations, danger also lurked, be it careening into the barrier or over the side after missing a wire on landing. George Bush had been in combat less than a month when a glance at his instrument panel after a catapult shot off *San Jacinto* proved a startling revelation. "Shortly after becoming airborne, I noticed that my fuel pressure was gone – zilch, zero ... I was forced to land in the water ... with four 500-lb depth charges in my bay. Fortunately, I got the tail down and came to a rather level halt. My crewmen and I scrambled out into the life raft. I must confess I did worry about those four depth charges going off and transforming our little raft into a lunar rocket."

Many Avenger crews did not experience the crucible of combat or a hairy crash as related above; to a man, however, World War II was a defining experience in their lives. The war held an additional significance for the aircraft they flew, for when the mushroom clouds over Hiroshima and Nagasaki brought an end to hostilities, so, too, did it signal the end of an era. The torpedo mission for which the aircraft had been designed ceased to exist, and in a post-war navy the venerable aircraft would assume much different roles.

Eyes of the fleet

Even before the end of World War II, the US Navy was preparing the Avenger for its post-war role. In early 1943 scientists at the Radiation Laboratory at the Massachusetts Institute of Technology initiated development of what would become the APS-20 airborne early warning (AEW) radar. Codenamed Project Cadillac, the development of the equipment included the use of a modified Avenger, stripped of armour, guns and ball turret, as an aerial testbed. This XTBM-3W was externally recognisable because of the bulbous 8 x 3-ft (2.4 x 0.9-m) dish antenna located between the landing gear and the supplemental fins affixed to the horizontal stabiliser. Internally, the modified torpedo-bomber's fuselage was transformed into a maze of antennas and transmitters that surrounded the radar operator's seat.

With the kamikaze threat sparking the need for greater airborne early warning capability, the Navy moved quickly on Project Cadillac. The service ordered 40 APS-20 sets in June 1944, a full two months before the first TBM-3W made its maiden flight. Testing began in earnest in October 1944 and continued into 1945, including carrier compatibility trials aboard *Ranger* (CV-4) off the California coast in April of that year. The results of this shipboard experimentation were encouraging, with the detection of single aircraft targets and aircraft formations occurring at ranges two and two to four times greater than shipboard radar,

Uruguay was the largest of two Latin-American customers for the Avenger, acquiring 19 aircraft, a mix of TBF-1s, TBM-1s and TBM-1Cs. A-501 was part of the second batch, delivered in 1950. Note the DF 'football' above the canopy, a modification otherwise only seen on some civil TBMs.

The Japanese Maritime Self-Defence Force acquired 20 TBM-3S (above) and -3W2 Avengers (below) in 1954, making 10 hunter-killer pairs. Three of the TBM-3Ss are preserved in Japan, including No. 2344 at the top of the formation above, which is now displayed at Kure AB. The aircraft were withdrawn from service in 1960.

respectively.

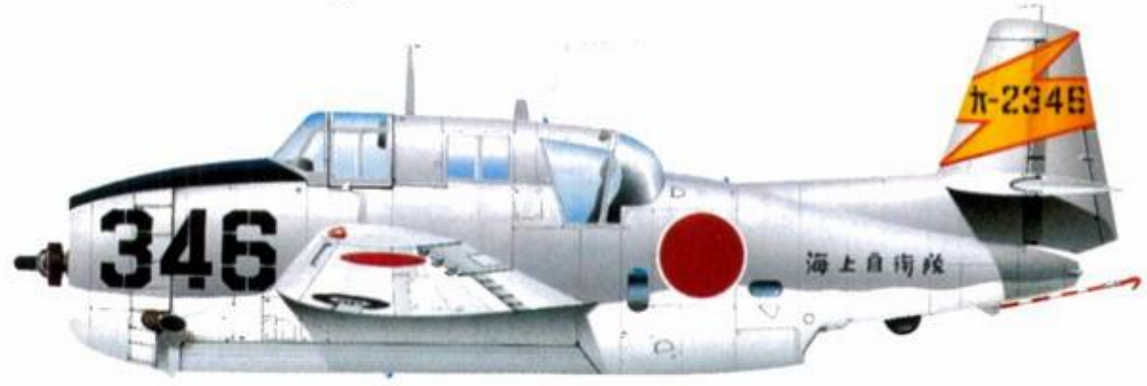
The end of the war did nothing to stagnate the development of airborne early warning, and the Chief of Naval Operations specifically addressed the need to evaluate the capabilities of aircraft involved in the mission, as well as the reliability of the APS-20. Initially, development of the TBM-3W fell to Fleet Electronic Training Units in both the Atlantic and Pacific fleets, but by 1948 the first Airborne Early Warning Squadrons (VAW), VAW-1 in San Diego and VAW-2 at Norfolk, had been formed. They were redesignated VC squadrons in September 1948. Detachments from the two units, each numbering three to four aircraft, were assigned to Navy carriers. Typically, these Avengers operated up to 70 miles (113 km) from the flat-top, flying at altitudes between 2,000 and 5,000 ft (610 and 1524 m). A datalink transmitted information to a radar receiving unit aboard the carrier, which in turn fed the data to the ship's Combat Information Center, where it was used in vectoring combat air patrol fighters.

TBM-3Ws served as the Navy's primary AEW aircraft until 1950, when they were replaced by the more capable AD-3W Skyraider. However, modified TBM-3W2 aircraft remained in the fleet into the 1950s. Carrying APS-20 – capable of varying sweep widths of up to 60 nm (69 miles; 110 km) against the snorkel of a submerged submarine, depending on the sea state – these aircraft operated in Anti-submarine Squadrons (VS) alongside another modification

Export Avengers

Aéronavale
This French TBM-3W2 wears 4F markings, plus 'Suez stripes' left over from an assignment to 9F during Operation Musketeer.

MLD
TBM-3E2 U-29, coded '071', was previously BuNo. 53099 and FAA XB382. It served with No. 4 Squadron.



JMSDF
Japan's TBM-3S2 'killers' were painted in gull grey over white, and the TBM-3W2 'hunters' were overall dark blue.

of the Avenger, the TBM-3S. Designed specifically for anti-submarine work, they featured among other things a searchlight beneath the port wing. Operating in hunter-killer teams, they flew in front-line squadrons until replaced by Grumman's AF Guardian, which joined squadrons from October 1950.

Delivery truck to the fleet

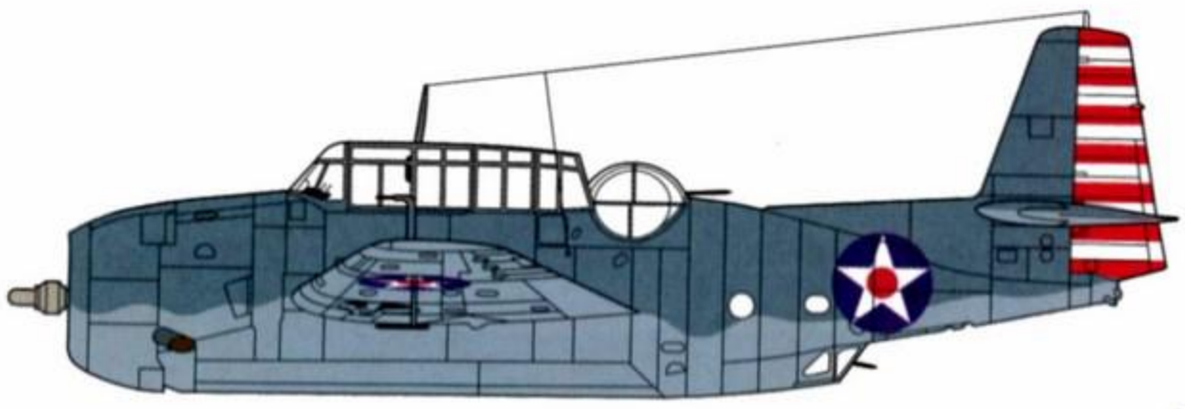
When war broke out in Korea, the aircraft that had played such a pivotal role in winning the previous war was on the scene, albeit in a much different role. In October 1950 the first TBM-3Rs arrived in the Far East. Modifications of the TBM-3E, these Avengers were designed to carry not deadly ordnance, but people and cargo. With five seats arranged in the fuselage and storage baskets in the bomb bay, these former torpedo-bombers became the first aircraft to equip organised squadrons whose mission was the delivery of personnel and cargo to carriers at sea. Thus, just as the Avenger was on the scene for the birth of airborne early warning, so too was the venerable aircraft part of the development of carrier onboard delivery (COD).

Without a dedicated transport squadron (VR) estab-

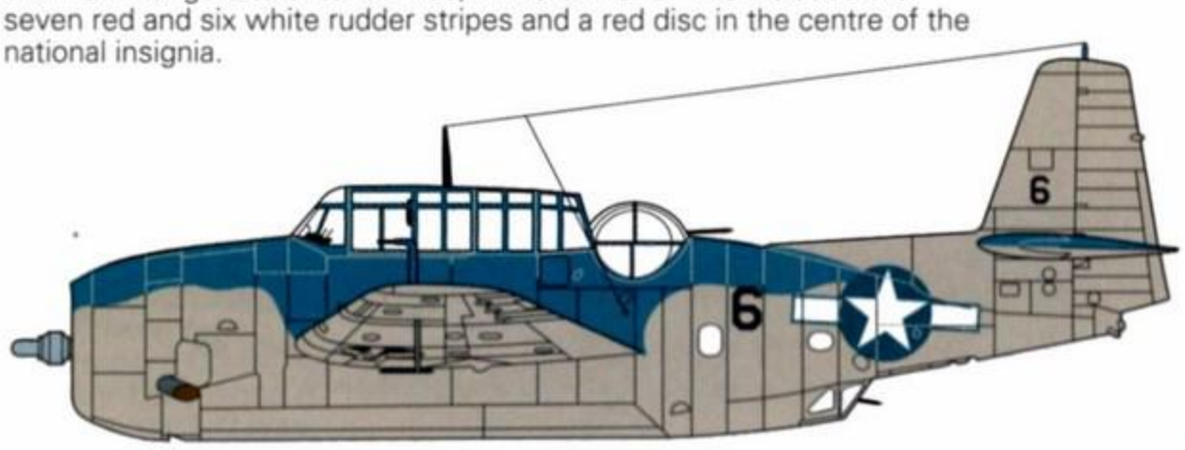
Far left and left: The survivors of the RNZAF's 48 aircraft soldiered on in various support roles in New Zealand until the late 1950s. With turrets removed and a high-visibility finish, the majority were used as target-tugs at various bases until the last were retired in 1959. Another use for the Avenger was in trials of the feasibility of topdressing (fertilising) pasture from the air. The success of these trials proved of immense benefit to New Zealand, spawning a whole new industry. NZ2504, seen as a target-tug (far left) and undergoing topdressing trials with a Harvard chase plane, is now on display at the RNZAF Museum at Wigram.

Avenger Colours

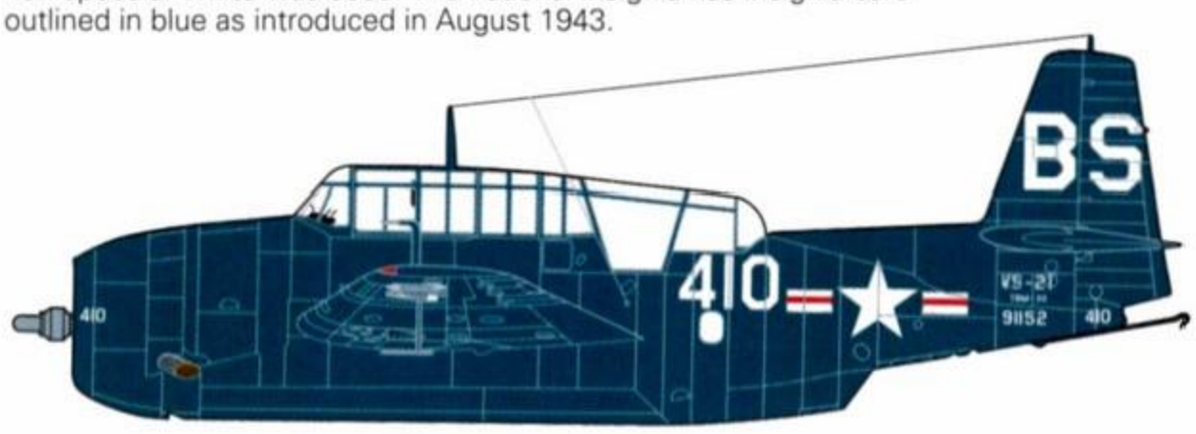
United States



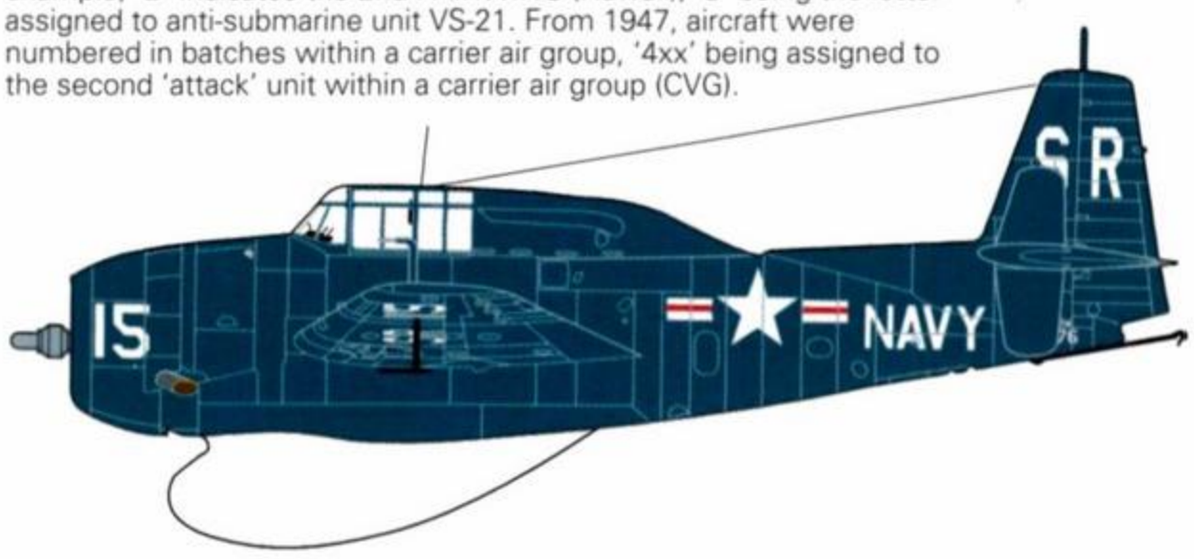
Above: The standard two colour non-specular (flat) blue-grey over light grey scheme applied to fleet aircraft from February 1941, appeared on the first Avengers to enter service, in March 1942. This included the seven red and six white rudder stripes and a red disc in the centre of the national insignia.



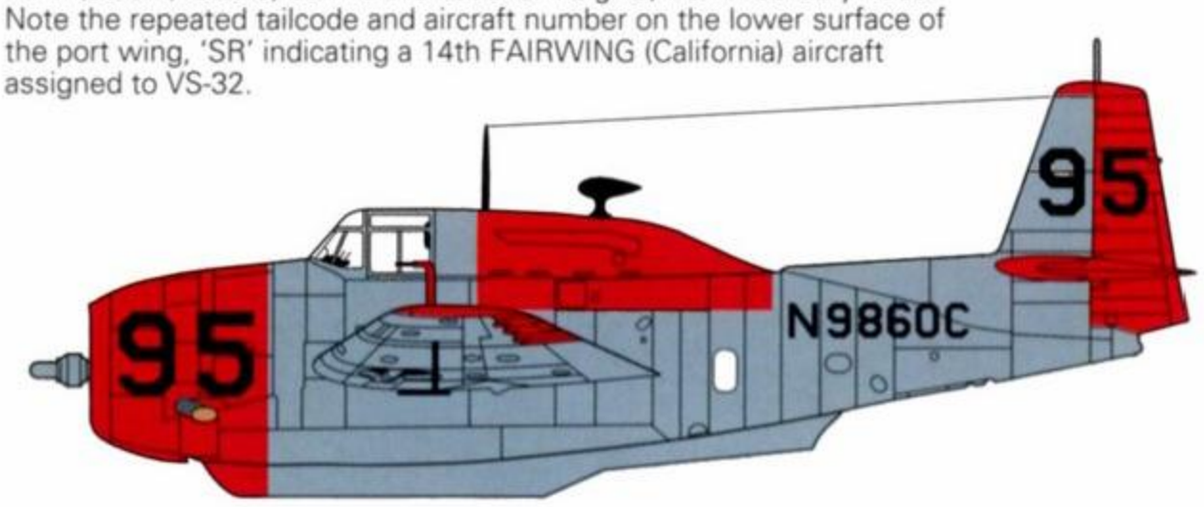
Above: For service in the Atlantic, USN Avengers were finished in a non-specular dark gull grey over glossy insignia white scheme. On the tail, non-specular white was used. The national insignia has insignia bars outlined in blue as introduced in August 1943.



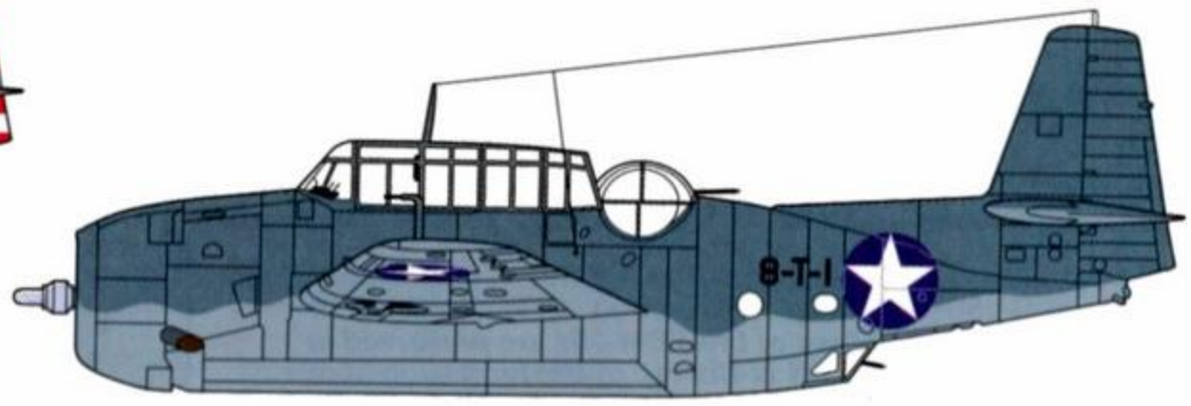
Above: The tailcodes on this 'midnight blue' TBM-3S are a combined Fleet Air Wing and unit marking of the type introduced in 1946. In this example, 'B' indicates the 2nd FAIRWING (Hawaii), 'S' being the letter assigned to anti-submarine unit VS-21. From 1947, aircraft were numbered in batches within a carrier air group, '4xx' being assigned to the second 'attack' unit within a carrier air group (CVG).



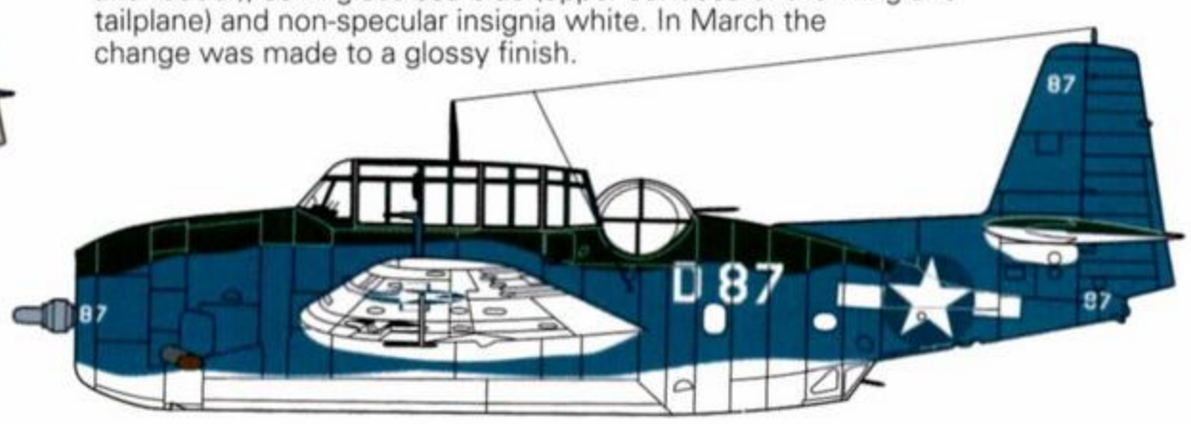
Above: The red stripe within the bars of the national insignia were introduced from January 1947, 'NAVY' appearing on the rear fuselage, in 12-in (30-cm) letters, behind the national insignia, from February 1950. Note the repeated tailcode and aircraft number on the lower surface of the port wing, 'SR' indicating a 14th FAIRWING (California) aircraft assigned to VS-32.



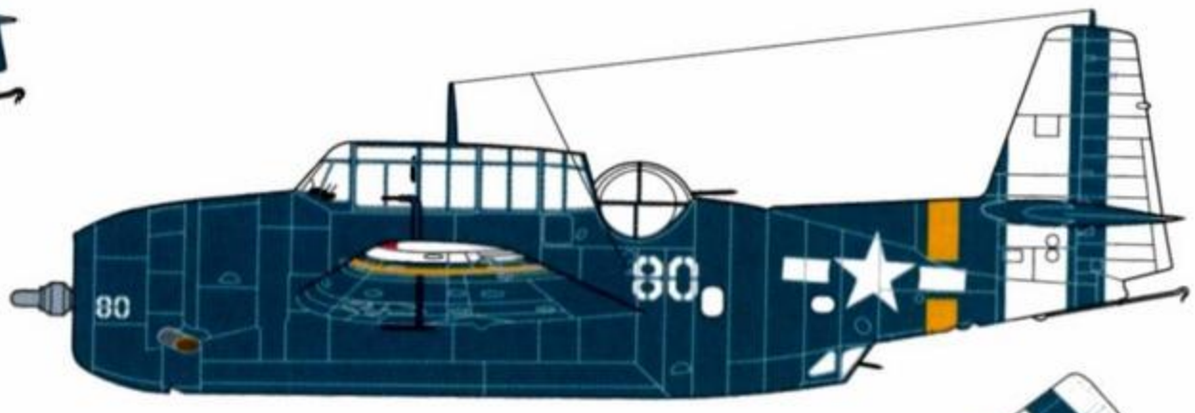
Below: Weathering took its toll on the appearance of combat aircraft, especially those at sea, their colours often fading. From May 1942, all red in the national markings was deleted, the rudder being finished in blue-grey to match the rest of the upper fuselage. This aircraft carries the markings of VT-8, with which the type made its combat debut in 1942.



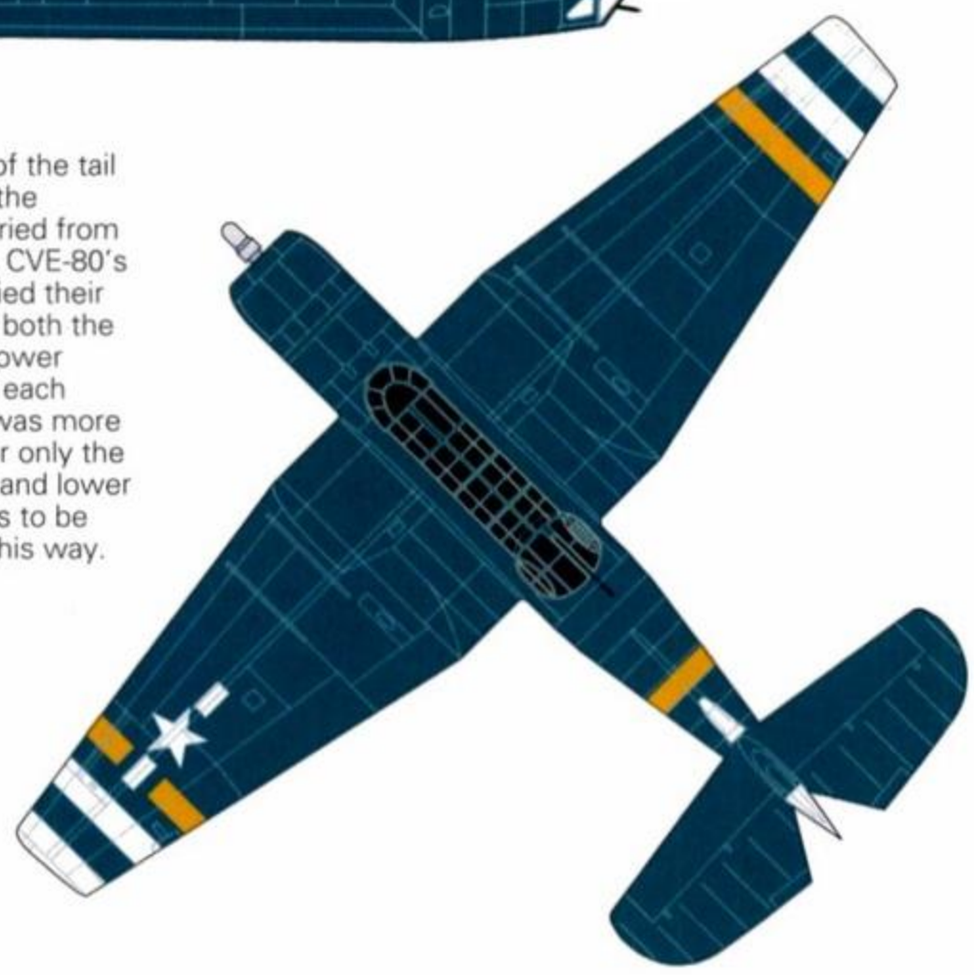
Below: In February 1943 the two-colour non-specular scheme was replaced by the Basic (Non-Specular) Camouflage Scheme consisting of non-specular sea blue (for the upper fuselage), non-specular intermediate blue (fuselage sides, vertical tail and rudder), semi-gloss sea blue (upper surfaces of the wing and tailplane) and non-specular insignia white. In March the change was made to a glossy finish.



Below and bottom: Overall glossy sea blue, previously confined to fighter aircraft, was introduced fleet-wide in October 1944 and was commonly known as 'midnight blue' or 'midnite blue'. In June 1945, new markings were introduced for CVE-based aircraft, aircraft from each CVE carrying a different combination of broad white and/or yellow bands. This VC-90 aircraft was based aboard CVE-80 USS *Petrof Bay*.

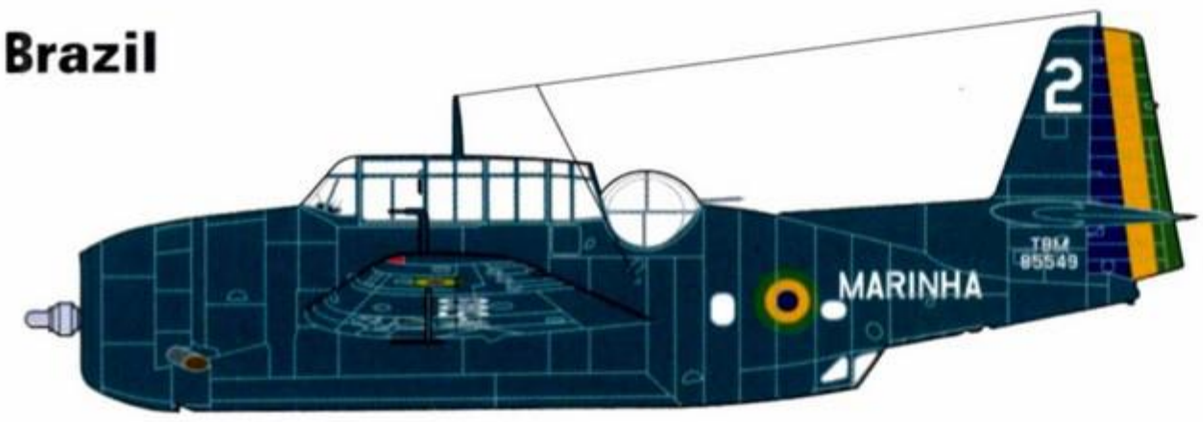


Repetition of the tail striping on the wingtips varied from unit to unit. CVE-80's aircraft carried their marking on both the upper and lower surfaces of each wingtip. It was more common for only the upper right and lower left wingtips to be marked in this way.



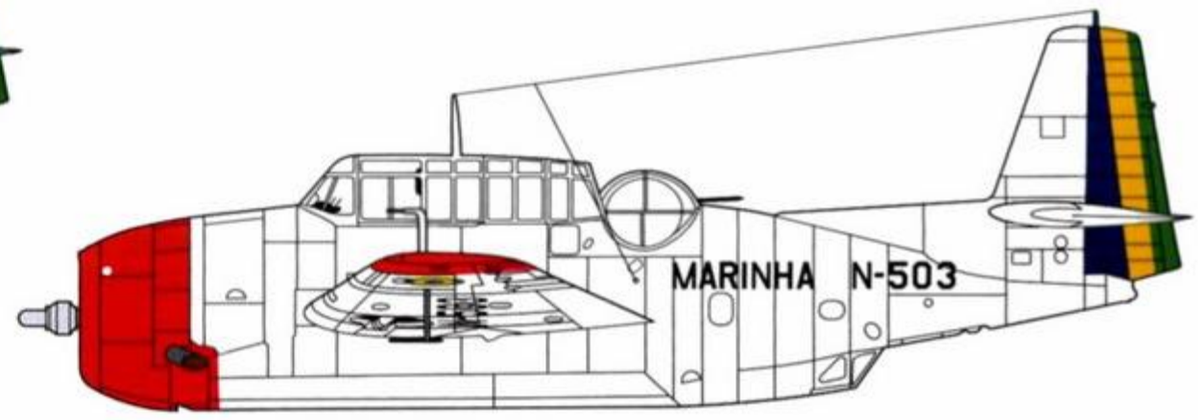
Left: Surplus Avengers (like this former TBM-3W) converted for fire-bombing and the like have appeared in an array of colour schemes, many including high-visibility colours to aid conspicuity in their low-level operating environment and to speed rescue efforts should the aircraft crash in a heavily forested area.

Brazil

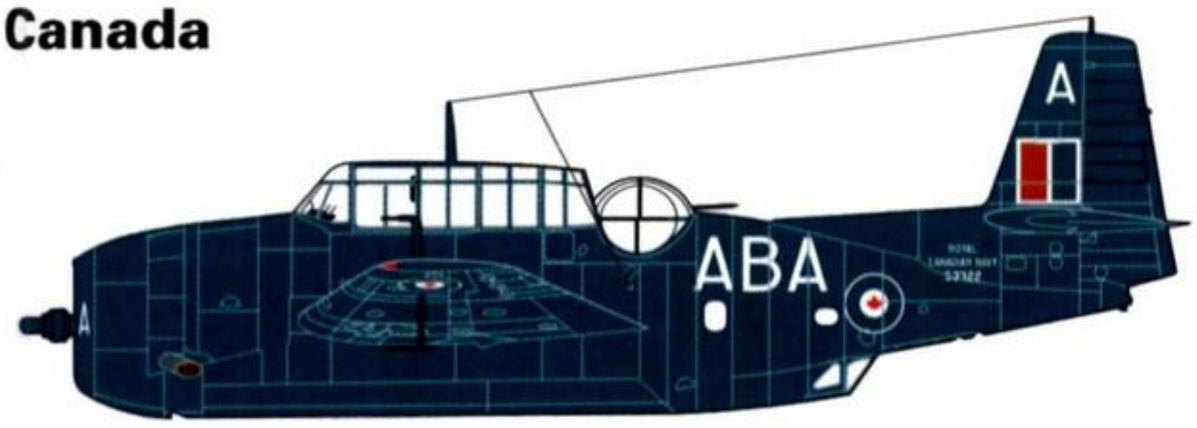


Above: Brazilian navy TBMs were noted in both ocean grey over gull grey and an overall glossy sea blue scheme. Colours from the national insignia (blue/yellow/green) were repeated on the rudder, other markings appearing in white.

Below: Later in their service, overall white was applied, with a red cowling and wingtips. While the rudder striping was retained, the fuselage national insignia was deleted. Lettering was black.

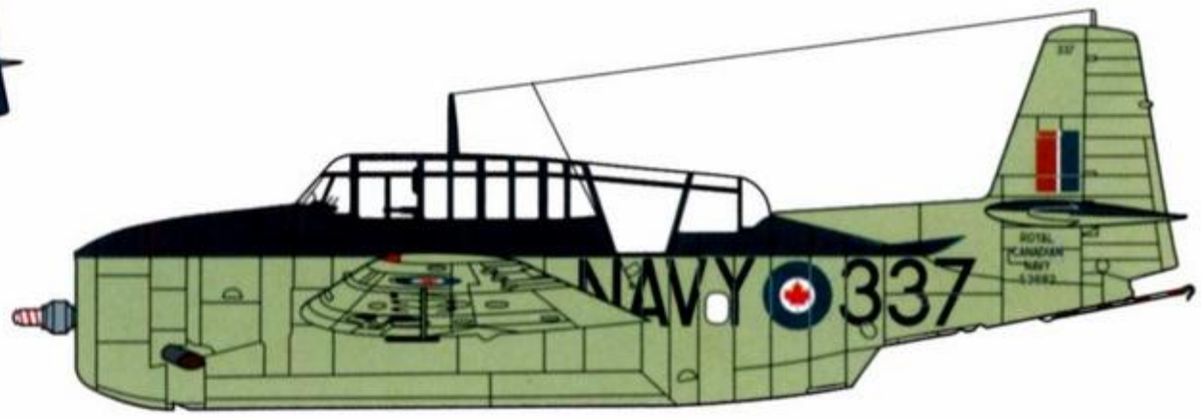


Canada

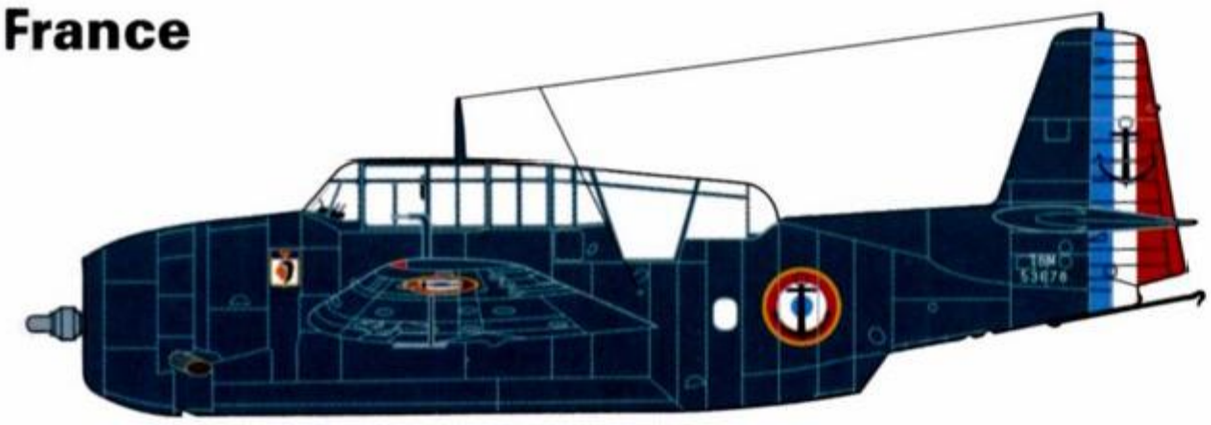


Above: When first delivered, the Royal Canadian Navy's aircraft were finished in USN standard glossy sea blue overall, with white lettering. A British-style red-white/blue flash appeared on the fin, the fuselage roundel featuring a maple leaf, as adopted by the Canadian forces post-war.

Below: This TBM-3S carries the dark grey over light grey scheme adopted later by the RCN. Unit codes, based on the aircraft's callsign, were abandoned in favour of a general three-digit number in the '3xx' series and large 'NAVY' lettering.

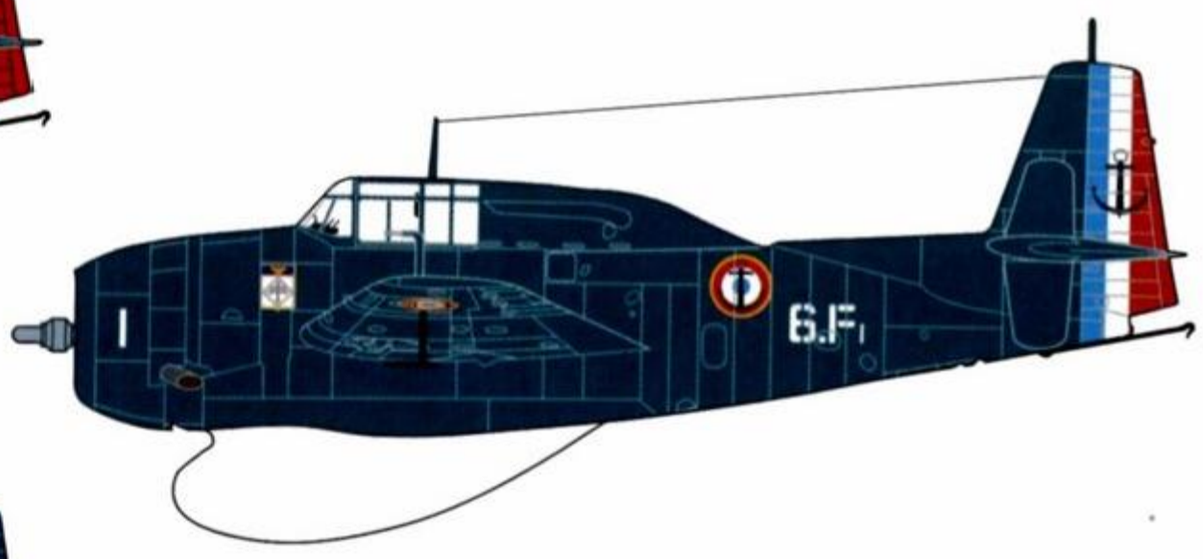


France

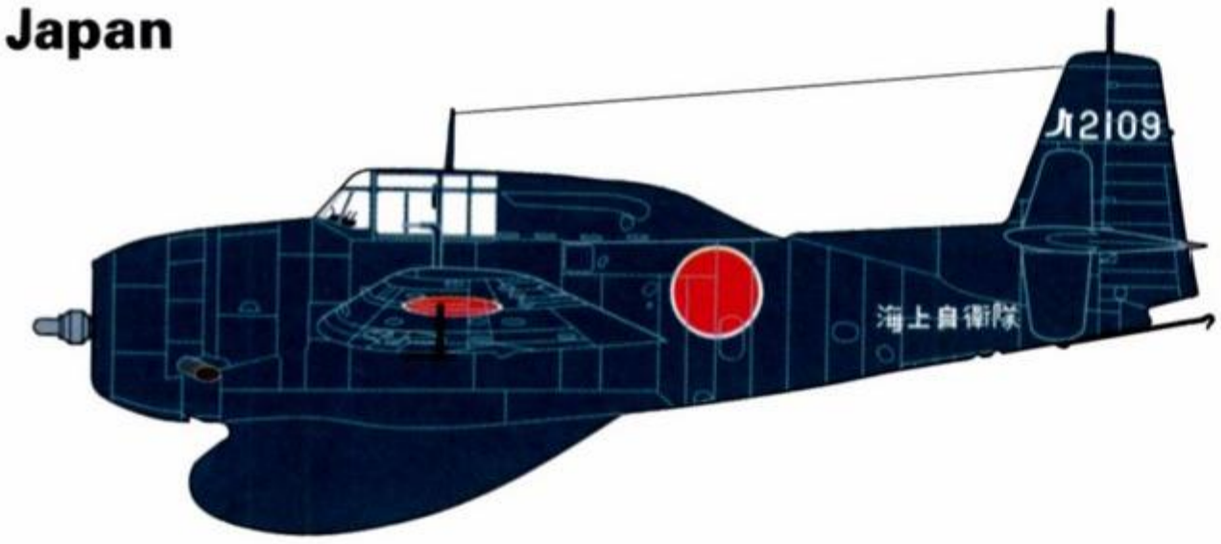


Above: Aéronavale TBMs were finished in standard 'midnight blue' throughout their careers, with *tricolore* rudder stripes. Other markings were minimal, often consisting only of national insignia and unit markings.

Below: This Aéronavale TBM-3W2 has a fuselage marking giving its unit (6 Flottille) and an aircraft number ('1'). Those TBM-3W2s that were active during the Suez Crisis carried yellow fuselage and wing stripes.

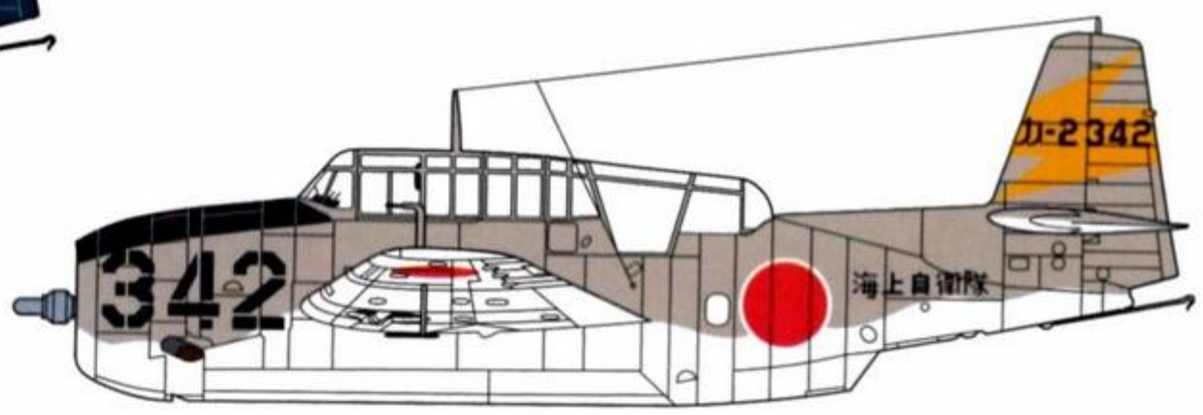


Japan

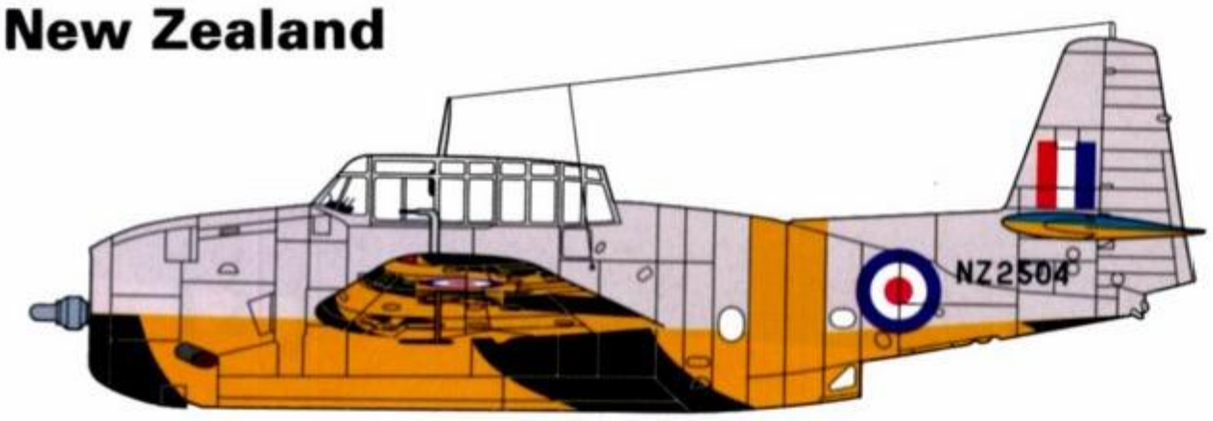


Above: In common with many other MDAP Avenger operators, the JMSDF flew its TBM-3W2s in 'midnight blue', with minimal additional markings. Note the painted radome; these were often left unpainted by the USN and other operators.

Below: Japan's TBM-3S2 fleet was finished in this light grey over white colour scheme, with a black anti-glare panel in front of the cockpit. The 'last three' of the aircraft's serial number appears on the engine cowling.

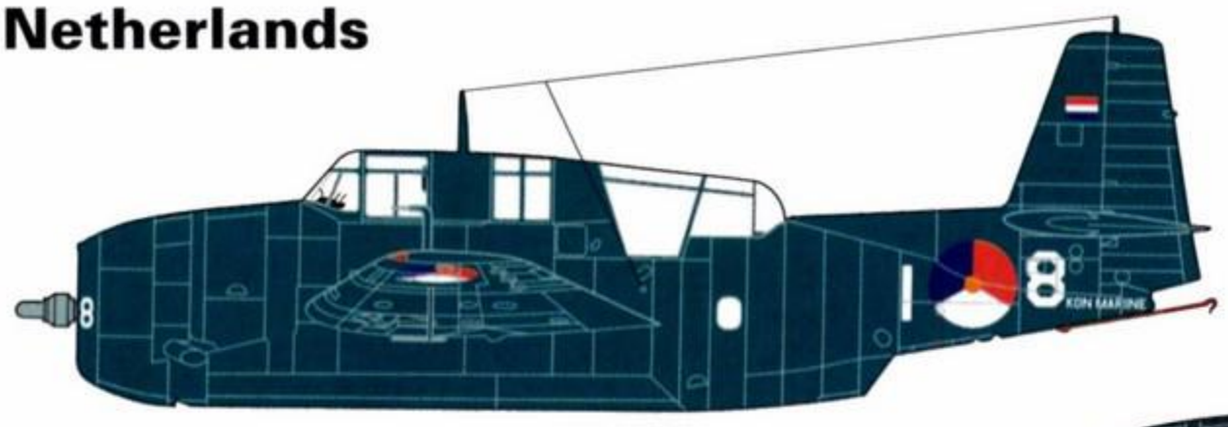


New Zealand



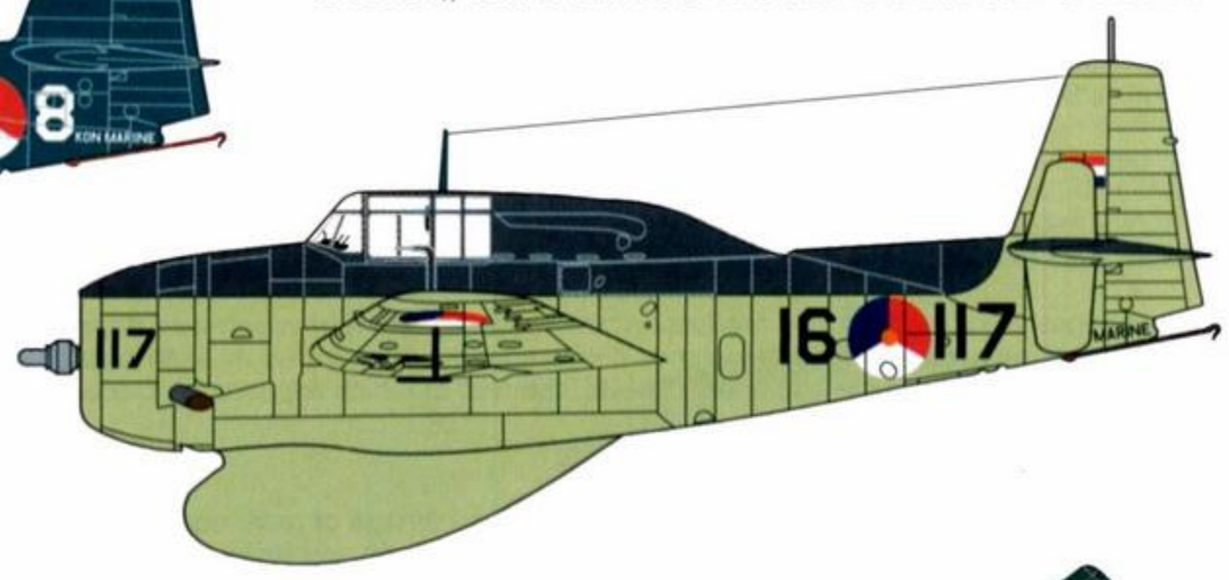
Left: The RNZAF's Avenger target tugs, operated into the late 1950s, were finished in natural metal with high-visibility yellow fuselage undersurfaces, a yellow fuselage band and alternating black/yellow striping on the undersurfaces of the mainplane and tailplane.

Netherlands

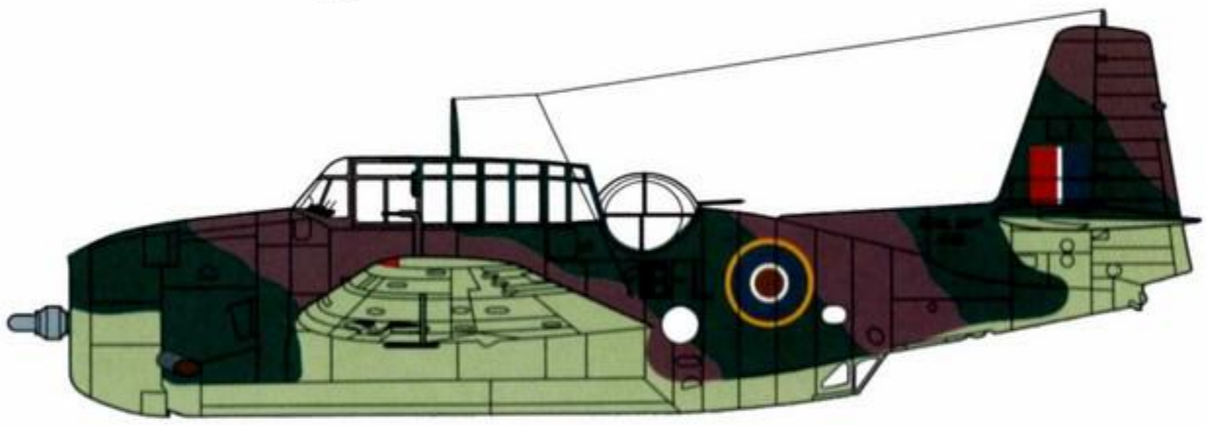


Above: Another MDAP Avenger operator with 'midnight blue' aircraft, the MLD applied a national marking and a serial number, in this case '1-8', a TBM-3S2.

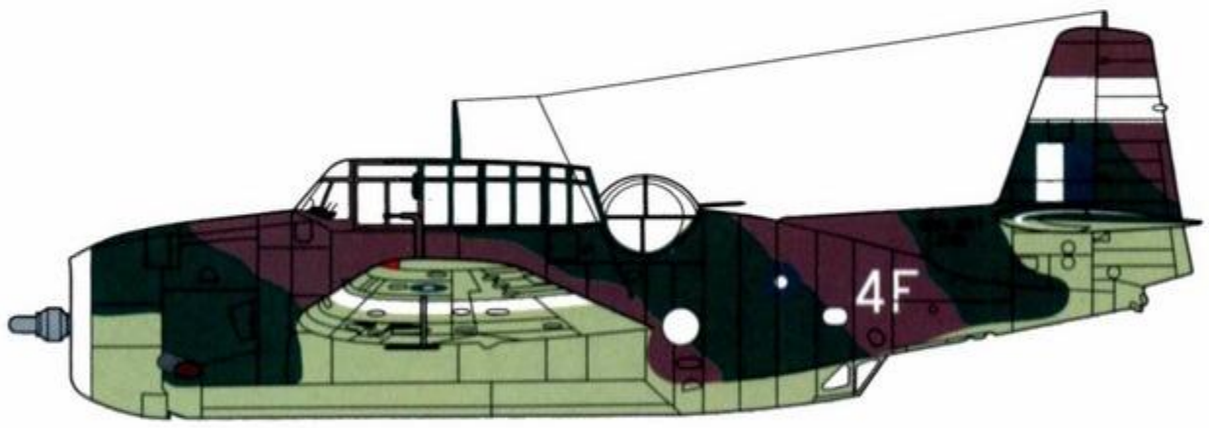
Below: A dark grey over light grey scheme, similar to that applied to RCN aircraft, was applied later to MLD aircraft, including TBM-3S2s and -3W2s. The Dutch Avengers were originally serialled in three discrete batches according to their variant (the -3W2s from 16-101 to 16-124), but the survivors were later renumbered in one series.



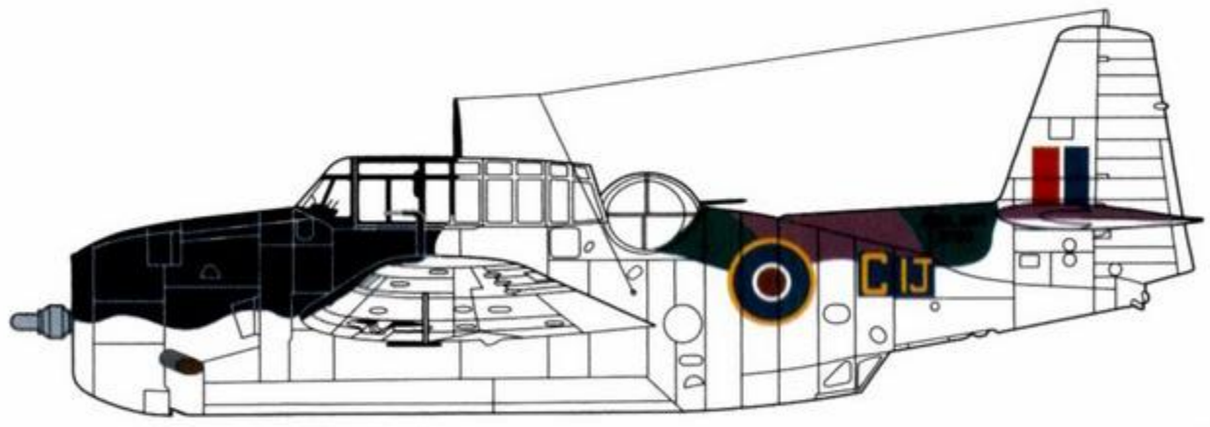
United Kingdom



Above and right: Based in the US and designated Tarpon Mk I in 1943, this No. 738 Squadron aircraft has standard FAA extra dark sea grey and dark slate upper surfaces, with sky undersurfaces. All lettering was in black, Type 'C1' roundels were applied to the fuselage, with two-colour Type 'B' roundels on the upper wing surfaces.

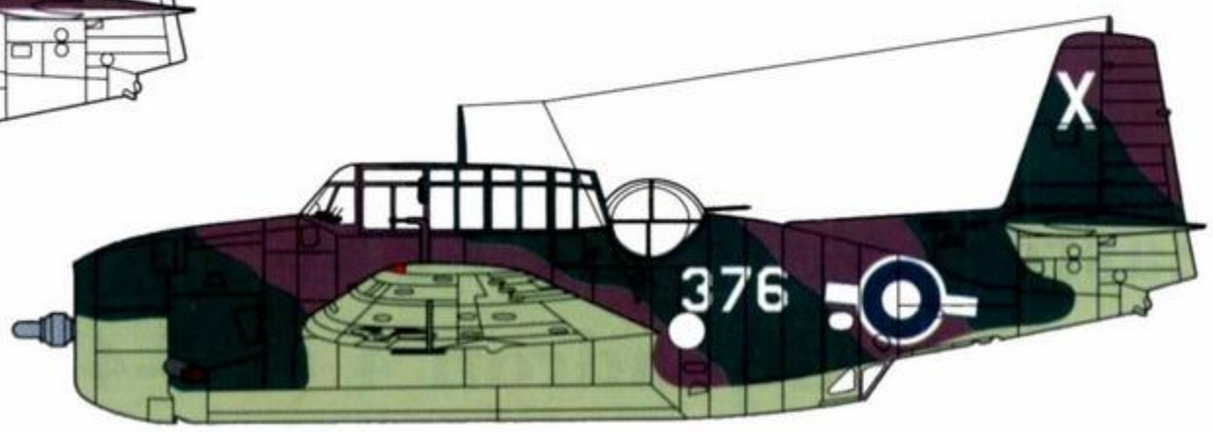


Left: Extra dark sea grey and dark slate grey camouflage over sky undersides were applied to Avengers in the British Pacific and East Indies fleets. SEAC national markings were also applied, along with white nose ring, wing and fin stripes.

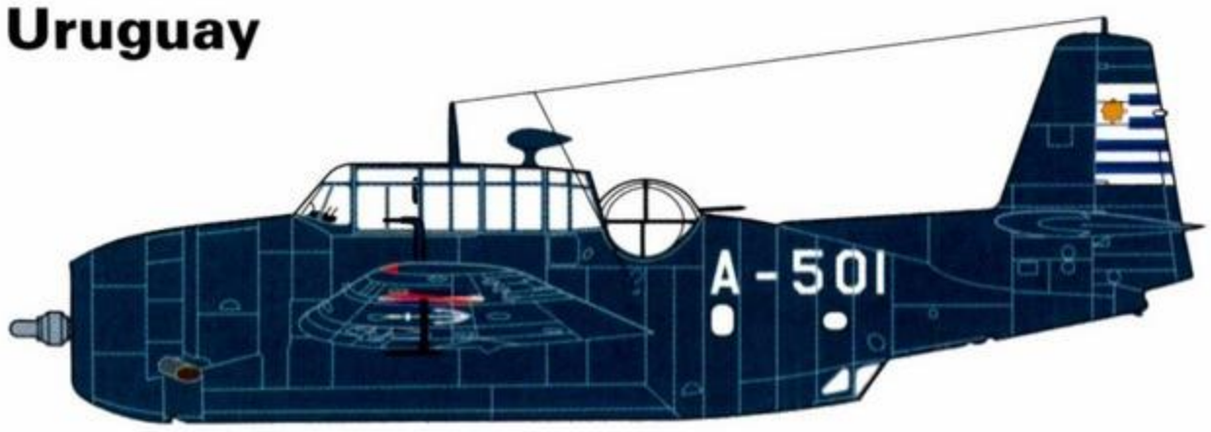


Above: This No. 711 Squadron Avenger Mk I was overpainted with a white fuselage and underwing surfaces, along with a black nose and wing leading-edges for night anti-submarine and mine-laying duties while based at Crail, Scotland in 1945.

Below: This No. 848 Squadron Avenger Mk II, operating in the Pacific in 1945, has Pacific area national markings, a carrier tailcode ('X' for HMS *Formidable*) and a '3xx' aircraft number.



Uruguay



Left: Uruguay's early model Avengers (like this TBF-1) appear to have been finished in 'midnight blue', with a serial number in white on the rear fuselage, the national flag on the rudder and both national and naval insignia on the undersurface of at least one wing.

Eastern Aircraft Division's TBM-3s

Built in the greatest numbers of all the Avenger variants, the TBM-3 (effectively an Eastern Aircraft-built TBF-3) began leaving the Trenton, New Jersey plant in April 1944. The New Jersey plant manufactured forward and centre fuselage sections and assembled a complete aircraft, bringing together other components from plants in Tarrytown, New York (wings and cowlings), Baltimore, Maryland (rear fuselages) and Bloomfield, New Jersey (electric and hydraulic systems).

After four XTBM-3s (BuNos 25175, 25521, 25700 and 45645), 4,207 production TBM-3s were built, in batches as follows:

BuNos 22857-23656	800 aircraft
BuNos 68062-69538	1,477 aircraft
BuNos 85459-86292	384 aircraft
BuNos 91107-91752	646 aircraft

A number of aircraft from two batches were cancelled:

BuNos 86293-86296	(4 aircraft)
BuNos 91753-92006	(254 aircraft)

A few changes were made during production, the most important of which was the replacement of the Norden bombsight with an automatic pilot. The 3,307 machines delivered were augmented by examples of the last Avenger variant to enter wartime production, the radar-equipped TBM-3E, the first of which appeared in December 1944:

BuNos 53050-53949	900 aircraft

In the -3E, weight reduction had been necessary to allow carriage of radar equipment, and during production further weight-saving measures were taken, including removing the ventral gun and replacing the armour plate fitted to the rear of the aircraft with a flak suit for the crewman and two flak curtains. Towards the end of production, twin 0.5-in (12.7-mm) gun packs could be carried beneath the aircraft's wings and ultraviolet spotlights were fitted in the cockpit to aid night operations

During the course of its service history, numerous TBM-3s served as the basis for a number of sub-variants and were variously modified and redesignated as a follows:

TBM-3D	ASW variant fitted with AN/APS-3 radar
TBM-3E2	post-war 'modernised' TBM-3E; most aircraft had external arrester hook in place of original 'stinger' hook
TBM-3H	*possible designation of aircraft fitted with unknown type of search radar*
TBM-3J	'winterised' version
TBM-3L	fitted with retractable searchlight in bomb bay
TBM-3M	TBM-3s and -3Es equipped for missile and rocket testing
TBM-3N	night torpedo-bombing variant
TBM-3Q	radio countermeasures aircraft with AN/APS-20 radar
TBM-3R	post-war seven-seat COD conversion
TBM-3S	TBM-3s and -3Es fitted post-war with searchlight and datalink for ASW
TBM-3S2	TBM-3S with more advanced datalink
TBM-3U	conversion for utility roles, including target-towing
TBM-3W	AEW aircraft with AN/APS-20 radar
TBM-3W2	TBM-3W with radar optimised for snorkel detection

Specifications

	TBF-1	TBF-1C	TBM-3E	TBM-3W
span	54 ft 2 in (16.51 m)	54 ft 2 in (16.51 m)	54 ft 2 in (16.51 m)	54 ft 2 in (16.51 m)
span (wings folded)	19 ft 0 in (5.79 m)	19 ft 0 in (5.79 m)	19 ft 0 in (5.79 m)	19 ft 0 in (5.79 m)
length	40 ft 0 in (12.19 m)	40 ft 0 in (12.19 m)	40 ft 11.5 in (12.48 m)	41 ft 0 in (12.50 m)
height	16ft 5in (5.00 m)	16ft 5in (5.00 m)	16ft 5in (5.00 m)	16ft 6in (5.03 m)
wing area	490 sq ft (45.52 m²)	490 sq ft (45.52 m²)	490 sq ft (45.52 m²)	490 sq ft (45.52 m²)
weight, empty	10,080 lb (4572 kg)	10,555 lb (4788 kg)	10,545 lb (4783 kg)	11,893 lb (5395 kg)
weight, loaded	13,667 lb (6199 kg)	16,412 lb (7444 kg)	14,160 lb (6423 kg)	13,994 lb (6348 kg)
weight, maximum	15,905 lb (7214 kg)	17,364 lb (7876 kg)	17,895 lb (8117 kg)	14,798 lb (6712 kg)
maximum speed	271 mph @ 12,000 ft (436 km/h @ 3660 m)	257 mph @ 12,000 ft (414 km/h @ 3660 m)	276 mph @ 16,500 ft (444 km/h @ 5030 m)	260 mph @ 16,450 ft (418 km/h @ 5015 m)
cruising speed	145 mph (233 km/h)	153 mph (246 km/h)	147 mph (237 km/h)	144 mph (232 km/h)
climb rate	1430 ft/min (7.3 m/sec)	10,000 ft/13 mins (3.9 m/sec)	2,060 ft/min (10.5 m/sec)	1,695 ft/min (8.6 m/sec)
service ceiling	22,400 ft (6830 m)	21,400 ft (6525 m)	30,100 ft (9175 m)	28,500 ft (8685 m)
range with torpedo	1,215 miles (1955 km)	1,105 miles (1780 km)	1,130 miles (1820 km)	–
range as scout	1,450 miles (2335 km)	2,335 miles (3755 km)	1,920 miles (3090 km)	–

Note: The last operational Avenger fire-bombers, operated in New Brunswick, Canada by Forest Protection Limited (FPL), operate at a maximum gross weight of 17,600 lb (7983 kg), a typical load being 500 Imp gal (2273 litres) of long term retardant or foam. Fuel capacity is 271 Imp gal (1232 litres), the aircraft consuming an average of 60 Imp gal (273 litres) per hour and therefore having an endurance figure around 4.5 hours. FPL quote a maximum speed of 355 mph (571 km/h) in a dive or glide.

Eastern Aircraft TBM-3 Avenger
Torpedo Squadron 4 (VT-4)
Air Group 4 (CVG-4)
USS *Essex*
United States Navy
12 January 1945

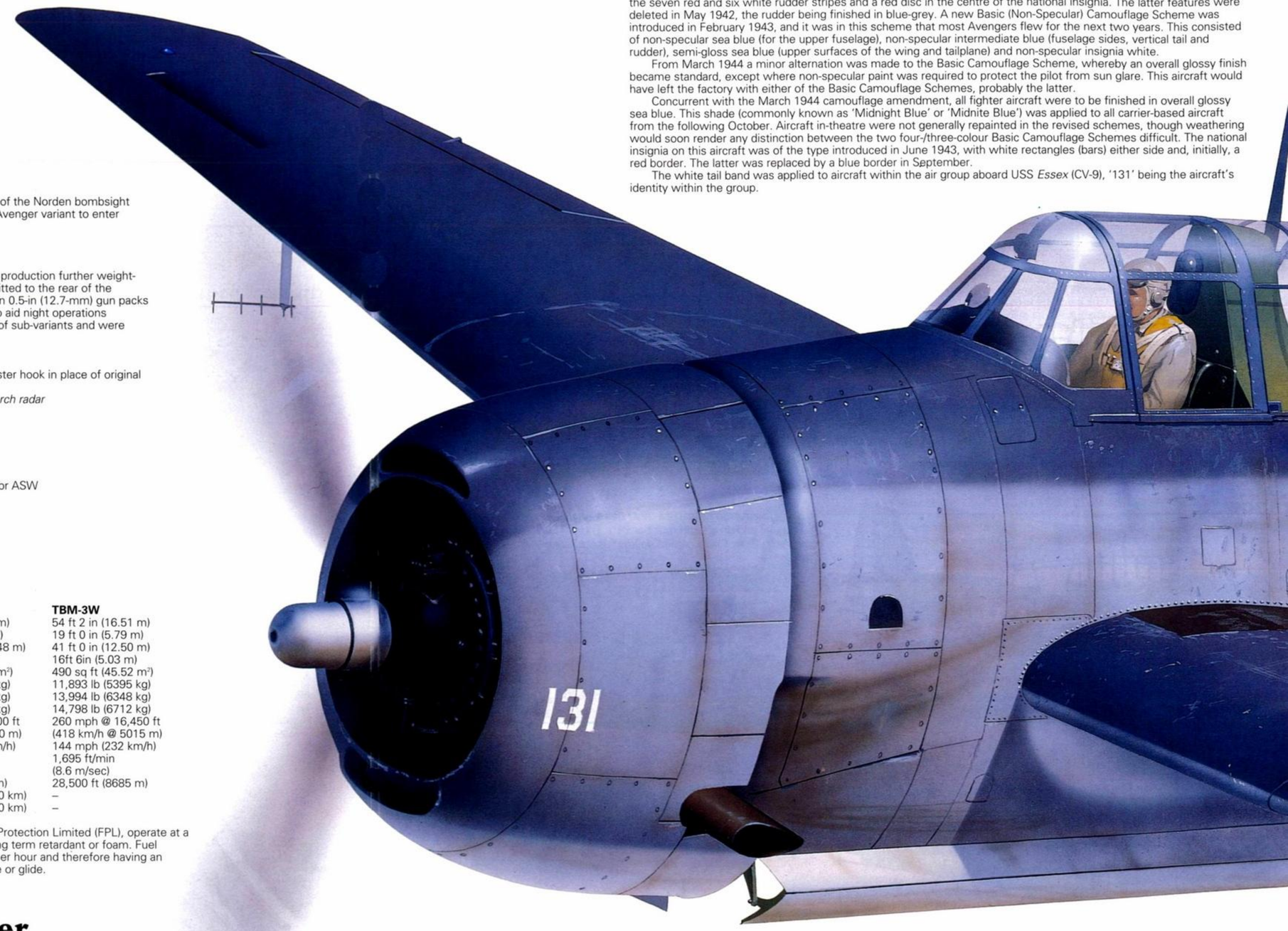
TBM colour schemes

USN Avengers in the Pacific theatre were initially (i.e., from March 1942) finished in the standard two colour non-specular (flat) blue-grey over light grey scheme applied to all fleet aircraft, dating back to February 1941. This included the seven red and six white rudder stripes and a red disc in the centre of the national insignia. The latter features were deleted in May 1942, the rudder being finished in blue-grey. A new Basic (Non-Specular) Camouflage Scheme was introduced in February 1943, and it was in this scheme that most Avengers flew for the next two years. This consisted of non-specular sea blue (for the upper fuselage), non-specular intermediate blue (fuselage sides, vertical tail and rudder), semi-gloss sea blue (upper surfaces of the wing and tailplane) and non-specular insignia white.

From March 1944 a minor alternation was made to the Basic Camouflage Scheme, whereby an overall glossy finish became standard, except where non-specular paint was required to protect the pilot from sun glare. This aircraft would have left the factory with either of the Basic Camouflage Schemes, probably the latter.

Concurrent with the March 1944 camouflage amendment, all fighter aircraft were to be finished in overall glossy sea blue. This shade (commonly known as 'Midnight Blue' or 'Midnite Blue') was applied to all carrier-based aircraft from the following October. Aircraft in-theatre were not generally repainted in the revised schemes, though weathering would soon render any distinction between the two four-/three-colour Basic Camouflage Schemes difficult. The national insignia on this aircraft was of the type introduced in June 1943, with white rectangles (bars) either side and, initially, a red border. The latter was replaced by a blue border in September.

The white tail band was applied to aircraft within the air group aboard USS *Essex* (CV-9), '131' being the aircraft's identity within the group.



Powerplant

Though consideration was given to fitting a 2,000-hp (1491-kW) Pratt & Whitney R-2800 Double Wasp to the TBM-3, Wright's R-2600-20 Cyclone 14 rated at 1,900 hp (1417 kW) was chosen instead, replacing the 1,600-hp (1193-kW) R-2600-8 of the previous production variant, the TBM-1C. A new engine was necessary to counter the marginal performance of the aircraft at normal gross weights, especially when operating from the small decks of escort carriers. The increased cooling requirements of the new variant necessitated some redesign of its cowling; multiple cowl flaps and an oil cooler intake on the lower lip were new features.

The 2,603-cu in (59042-cm³) capacity R-2600 – a 14-cylinder, twin-bank derivative of Wright's 1920s-vintage nine-cylinder R-1750/-1820 Cyclone – also powered the Curtiss SB2C Helldiver and, as such, is often described as one of America's 'war-winning' powerplant designs. Over 50,000 were built at Wright's Cincinnati plant.

TBM colour schemes
USN Avengers in the Pacific theatre were initially (i.e., from March 1942) finished in the standard two colour non-specular (flat) blue-grey over light grey scheme applied to all fleet aircraft, dating back to February 1941. This included the seven red and six white rudder stripes and a red disc in the centre of the national insignia. The latter features were deleted in May 1942, the rudder being finished in blue-grey. A new Basic (Non-Specular) Camouflage Scheme was introduced in February 1943, and it was in this scheme that most Avengers flew for the next two years. This consisted of non-specular sea blue (for the upper fuselage), non-specular intermediate blue (fuselage sides, vertical tail and rudder), semi-gloss sea blue (upper surfaces of the wing and tailplane) and non-specular insignia white.

From March 1944 a minor alternation was made to the Basic Camouflage Scheme, whereby an overall glossy finish became standard, except where non-specular paint was required to protect the pilot from sun glare. This aircraft would have left the factory with either of the Basic Camouflage Schemes, probably the latter.

Concurrent with the March 1944 camouflage amendment, all fighter aircraft were to be finished in overall glossy sea blue. This shade (commonly known as 'Midnight Blue' or 'Midnite Blue') was applied to all carrier-based aircraft from the following October. Aircraft in-theatre were not generally repainted in the revised schemes, though weathering would soon render any distinction between the two four-/three-colour Basic Camouflage Schemes difficult. The national insignia on this aircraft was of the type introduced in June 1943, with white rectangles (bars) either side and, initially, a red border. The latter was replaced by a blue border in September.

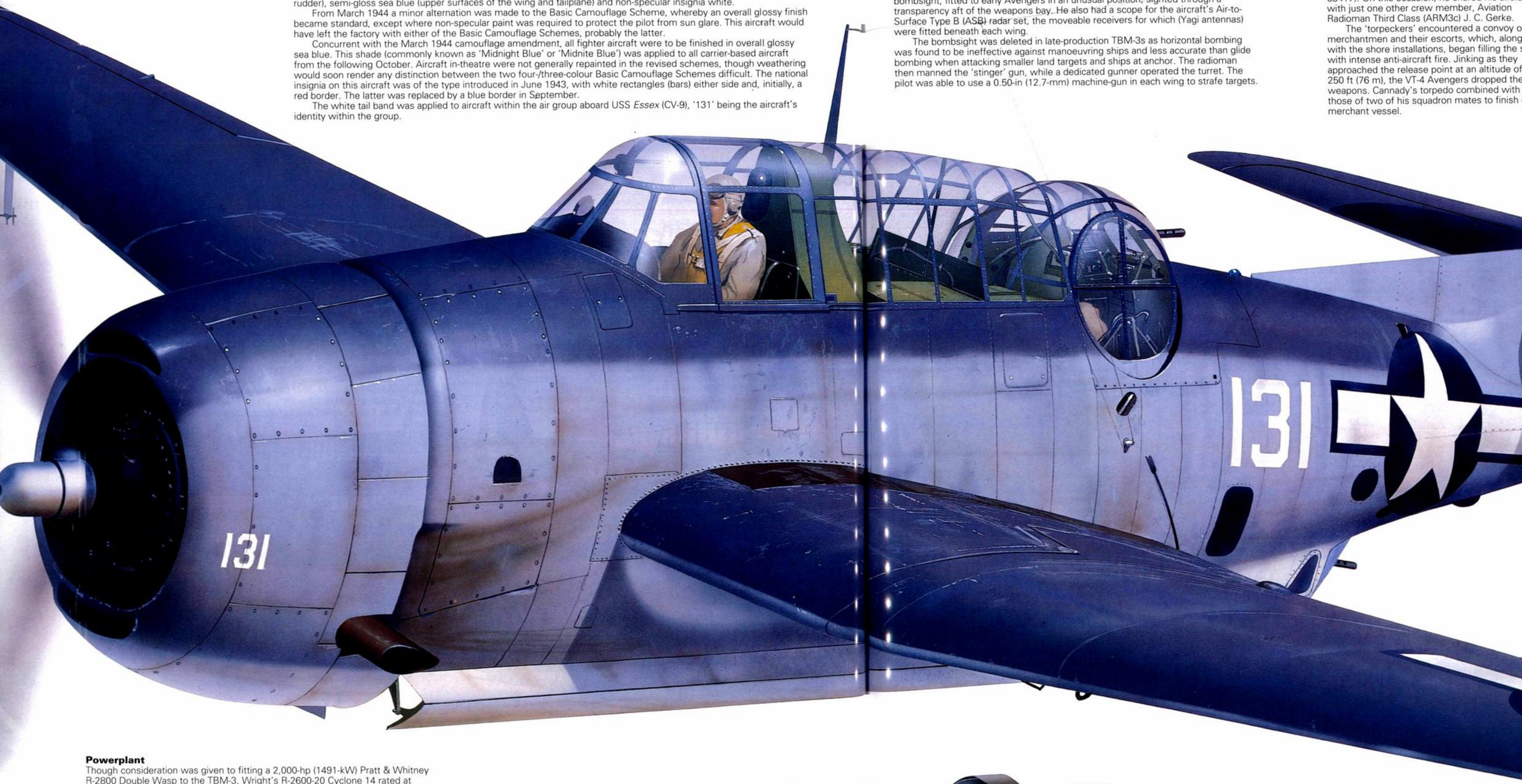
The white tail band was applied to aircraft within the air group aboard USS *Essex* (CV-9), '131' being the aircraft's identity within the group.

Crew
Three crew manned a typical TBM-3: a pilot, a radio operator and a bombardier. The pilot was housed in a separate cockpit, while the rear portion of the 'glasshouse' contained the radioman and his Grumman 150SE turret, with a 0.50-in (12.7-mm) machine-gun. The rest of the crew compartment consisted of the so-called 'tunnel' in which the bombardier manned a 0.30-in (7.62-mm) machine-gun in the ventral 'stinger' position. The bombardier's main piece of equipment was a Norden bombsight, fitted to early Avengers in an unusual position, sighted through a transparency aft of the weapons bay. He also had a scope for the aircraft's Air-to-Surface Type B (ASB) radar set, the moveable receivers for which (Yagi antennas) were fitted beneath each wing.

The bombsight was deleted in late-production TBM-3s as horizontal bombing was found to be ineffective against manoeuvring ships and less accurate than glide bombing when attacking smaller land targets and ships at anchor. The radioman then manned the 'stinger' gun, while a dedicated gunner operated the turret. The pilot was able to use a 0.50-in (12.7-mm) machine-gun in each wing to strafe targets.

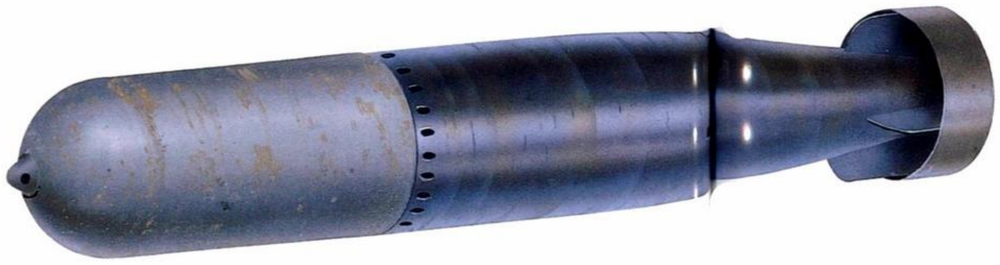
12 January 1945
On 12 January 1945, 12 TBM-3s loaded with torpedoes roared off *Essex*'s flight deck with mission of attacking shipping on the Saigon R near Cap St Jacques. Among the pilots was Ensign William H. Cannady, a relatively new p to VT-4, flying aircraft number '131' (TBM-3 B 68417). On this occasion, he shared his aircra with just one other crew member, Aviation Radioman Third Class (ARM3c) J. C. Gerke.

The 'torpeckers' encountered a convoy o merchantmen and their escorts, which, along with the shore installations, began filling the s with intense anti-aircraft fire. Jinking as they approached the release point at an altitude of 250 ft (76 m), the VT-4 Avengers dropped the weapons. Cannady's torpedo combined with those of two of his squadron mates to finish merchant vessel.



Powerplant
Though consideration was given to fitting a 2,000-hp (1491-kW) Pratt & Whitney R-2800 Double Wasp to the TBM-3, Wright's R-2600-20 Cyclone 14 rated at 1,900 hp (1417 kW) was chosen instead, replacing the 1,600-hp (1193-kW) R-2600-8 of the previous production variant, the TBM-1C. A new engine was necessary to counter the marginal performance of the aircraft at normal gross weights, especially when operating from the small decks of escort carriers. The increased cooling requirements of the new variant necessitated some redesign of its cowling; multiple cowl flaps and an oil cooler intake on the lower lip were new features.

The 2,603-cu in (59042-cm³) capacity R-2600 – a 14-cylinder, twin-bank derivative of Wright's 1920s-vintage nine-cylinder R-1750/-1820 Cyclone – also powered the Curtiss SB2C Helldiver and, as such, is often described as one of America's 'war-winning' powerplant designs. Over 50,000 were built at Wright's Cincinnati plant.



Torpedo
The Mk XIII 'ring-tailed' torpedo was developed at the California Institute of Technology by modifying the standard Mk XIII-1A with a 10-in (25.4-cm) steel band welded around the fins. These were first used in August 1944 by VT-13 from aboard USS *Franklin* west of Iwo Jima.

Compared to the unmodified torpedoes, which had to be dropped within a speed range of 100-110 kt (185-204 km/h), and a height of 100 ft (30.5 m), the 'ring tails' could be released from as high as 800 ft (244 m) and as fast as 280 kt (519 km/h).

The Mk XIII was designed for aircraft use in about 1938. It had a greater diameter (22.4 in/56.9 cm) than the standard 21-in (53.3-cm) naval torpedo, a steam turbine engine producing 95 bhp (71 kW), a weight of 3,050 lb (1383 kg), and a theoretical maximum speed and range of 46 kt (85 km/h) and 9,000 yd (8230 m), respectively.

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Bomb loads
As a glide- or skip-bomber, the Avenger carried a variety of weapons according to mission, but typical stores included one 2,000-lb (907-kg) general-purpose (GP), one 1,600-lb (726-kg) armour-piercing (AP), two 1,000-lb (454-kg) GP, four 500-lb (227-kg) GP, 12 100-lb (45-kg) GP or four 350-lb (159-kg) depth bombs. The latter was the primary anti-submarine weapon used by the Avenger, along with newly developed aircraft rockets. Rockets were introduced in late 1943, initially in 3.5-in (8.8-cm) form and later with 5-in (12.7-cm) heads. In early 1944, the first 5-in (12.7-cm) High Velocity Aircraft Rockets (HVARs) were used in combat, nicknamed 'Holy Moses'.

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Torpedo Squadron Four (VT-4) during World War II
Torpedo Squadron Four (VT-4) began life unconventionally on 10 January 1942. While most squadrons were established ashore, VT-4 came into being on the deck of the carrier USS *Ranger* (CV-4), while it was in port at Grassy Bay, Bermuda. Under the command of Lieutenant Wallace A. Sherrill, the squadron began operations flying the TBD-1 Devastator, a late 1930s-vintage aircraft which at the time was the Navy's front-line torpedo-bomber. Three months after its establishment, VT-4 enhanced its identity with the adoption of a squadron insignia – a goggled lion astride a torpedo sweeping the sea with a broom. Through the early months of 1942, VT-4 primarily logged training flights from *Ranger* while its sister squadrons fought the great carrier battles at Coral Sea and Midway. The only really notable happening was the transition to the more capable Grumman TBF-1 Avenger in August 1942.

VT-4's first taste of combat came in 1943. Following cruises ferrying Army Air Forces fighters to Morocco and assignment as an escort for the convoy carrying British Prime Minister Winston Churchill to Canada for the Quebec conference, *Ranger* joined the British Home Fleet in August for three months of operations. In the early morning of 4 October 1943, aircraft of Air Group Four, among them 10 TBF-1s of VT-4, launched strikes against German shipping along the Norwegian coast as part of Operation Leader. In this first US Navy carrier strike in northern Europe, the Avengers attacked targets at Bodø, sinking a freighter and small coastal vessel, and damaging a troop transport. *Ranger* returned to the United States in November 1943, and VT-4 continued to operate from its decks for the next six months. During that time the squadron received TBF-1C/TBM-1C Avengers.

On 1 May 1944 Air Group Four ended its long service aboard *Ranger*, reforming as a 90-ship spare air group for assignment to a large-deck 'Essex'-class carrier. Included in the group was VT-4, with an allotted 18 Avengers. In July the group received orders to move to the Pacific, transiting from San Diego to Pearl Harbor aboard the escort carrier USS *Barnes* (CVE-20). Tragedy marred VT-4's training in Hawaii, for a mid-air collision on 21 September 1944 claimed nine lives, including that of popular squadron skipper Lieutenant Commander Homer H. Hutcheson. Overcoming this loss, VT-4 entered combat on 11 November 1944, supporting General Douglas MacArthur's return to the Philippines from the deck of USS *Bunker Hill* (CV-17). In the ensuing days, the squadron struck targets at Ormoc Bay, Cavite, and Clark Field.

VT-4's Avengers did not stay aboard the *Bunker Hill* flight deck for long. In late November, Air Group Four transferred to USS *Essex* (CV-9), the lead vessel of the class of carriers that was sweeping across the Pacific. However, before combat operations from their new home could begin in earnest, *Essex* was the object of a kamikaze attack while operating in the waters off the Philippines. Crashing in a fireball, the suicide aircraft killed 15 sailors and wounded 44 others. Fortunately, damage from the attack required little time to repair, and *Essex* was back on the line by mid-December, again launching strikes against the Philippines.

January 1945 brought yet another change in aircraft for VT-4, this time in the form of the TBM-3. The new mounts arrived just in time for a sustained series of strikes against targets in the Western Pacific, including Formosa, Luzon and Hainan. Other missions were launched against French Indochina, a land that held little significance at the time, but would become a permanent part of the American conscience in years to come when it was known as Vietnam. VT-4 logged combat missions into March 1945, participating in the first strikes of US Navy carrier-based aircraft against the Japanese home islands and supporting the invasion of Iwo Jima in February, plus softening up the defences of Okinawa in March. On 4 March 1945 Air Group Four disembarked from *Essex* at Ulithi, concluding its last combat cruise of World War II.

VT-4, VA-2A and VA-15
Flying TBM-3E/Q Avengers, VT-4 logged flights at sea immediately following the war, participating in the shakedown cruise and part of the first deployment of USS *Tarawa* (CV-40). Fittingly, the squadron ended its existence just as it had begun – at sea. On 15 November 1946, while serving aboard *Tarawa*, VT-4 was redesignated VA-2A. Less than two years later, on 2 August 1948, the designator changed again, this time to VA-15.

Having re-equipped with Douglas AD-4 Skyraiders in 1949, the unit became part of a training air group the following year, training fleet pilots of attack aircraft, emphasising glide-bombing, dive-bombing, rocket firing and day/night tactics. It was also engaged in Skyraider carrier qualification flights. AD-4Ls joined the unit in March 1951, prior to a deployment aboard USS *Wasp* (CVA-18) for NATO's first naval operation, Operation Mainbrace, in the North Atlantic. Finally, AD-6s (redesignated A-1Hs in 1962) equipped the unit from May 1954 and were destined to remain with the unit for the next 11 years.

The following February the squadron deployed aboard *Midway*, supporting the evacuation of Chinese Nationalists from the Tachen Islands, the subject of bombardment by the People's Republic of China, and at the end of 1956 found itself aboard USS *Forrestal* (CVA-59), operating near the Azores during the Suez Crisis. Inflight refuelling (using 'buddy' stores) was added to VA-15's roles in September 1958.

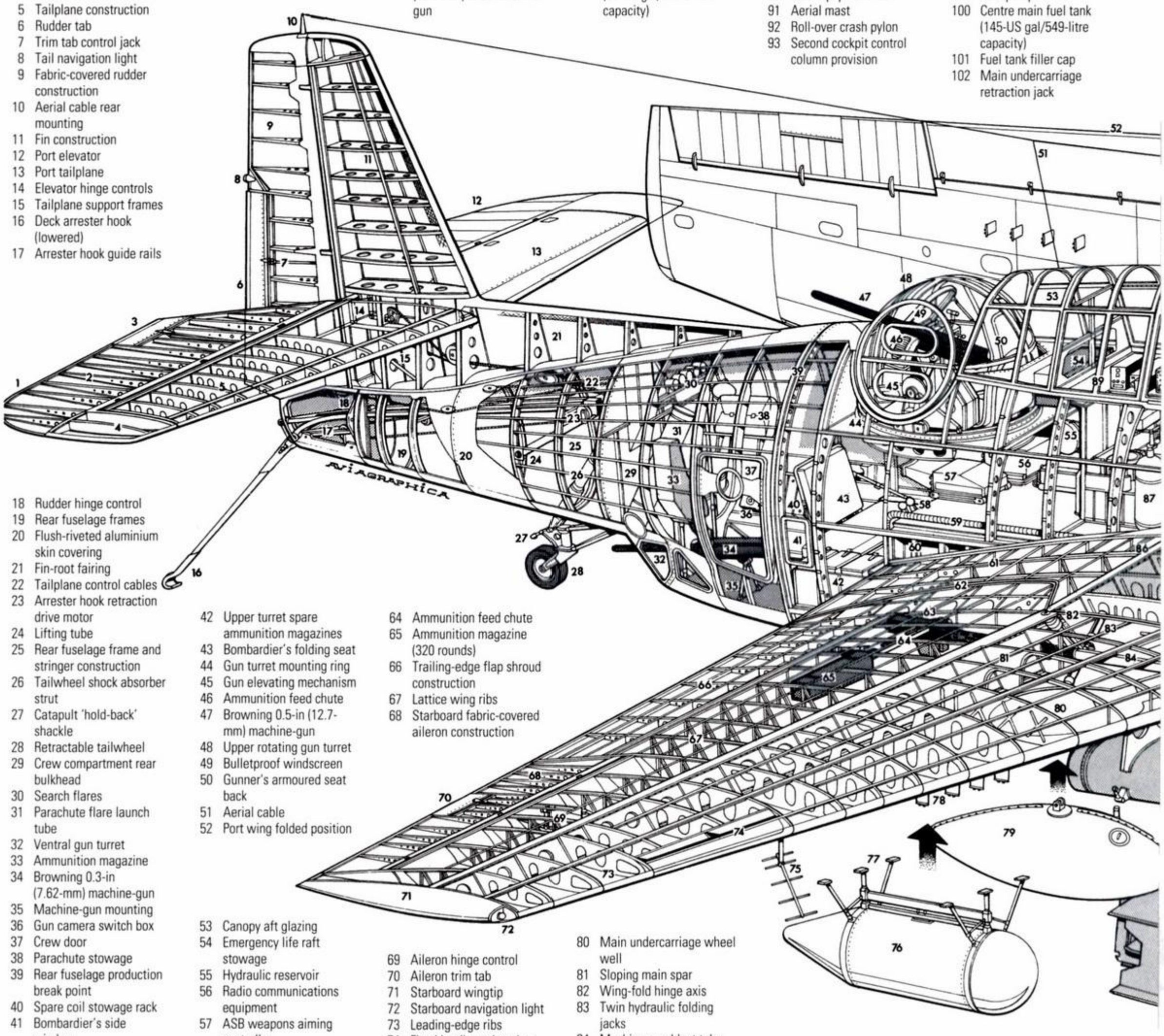
Between 1960 and 1961 further carrier deployments were made, notably in the Caribbean, while in 1962 the unit participated in the shakedown cruise of the first nuclear-powered carrier, the USS *Enterprise* (CVAN-65). In 1965 came the transition to jet aircraft in the shape of Douglas A-4B Skyhawks, on which VA-15 began training in August, ready for a return to the waters off Vietnam between April and November 1966. For combat in Southeast Asia, the unit formed part of an all-attack air wing (CVW-10) of four A-1 and A-4 squadrons aboard USS *Intrepid* (CVS-11). Its first combat mission in 21 years came on 15 May 1966. Re-equipped with A-4Cs in December 1966, the squadron was disestablished on 1 June 1969, its designator going to VA-67 the following day.

Avenger details

Far left: While the pilot clambered on to the wing to reach the cockpit, access to the TBM's crew compartment was gained via a door on the starboard side of the rear fuselage.

Left: In flight, the castoring tailwheel retracted out of the 'stinger' gun's field of fire . As a weight reduction measure, the ventral gun and its associated armour was removed from the TBM-3E.

TBM-1C Avenger cutaway



1 Starboard elevator
2 Fabric covered aileron construction
3 Elevator trim tab
4 Elevator horn balance
5 Tailplane construction
6 Rudder tab
7 Trim tab control jack
8 Tail navigation light
9 Fabric-covered rudder construction
10 Aerial cable rear mounting
11 Fin construction
12 Port elevator
13 Port tailplane
14 Elevator hinge controls
15 Tailplane support frames
16 Deck arrester hook (lowered)
17 Arrester hook guide rails
18 Rudder hinge control
19 Rear fuselage frames
20 Flush-riveted aluminium skin covering
21 Fin-root fairing
22 Tailplane control cables
23 Arrester hook retraction drive motor
24 Lifting tube
25 Rear fuselage frame and stringer construction
26 Tailwheel shock absorber strut
27 Catapult 'hold-back' shackle
28 Retractable tailwheel
29 Crew compartment rear bulkhead
30 Search flares
31 Parachute flare launch tube
32 Ventral gun turret
33 Ammunition magazine
34 Browning 0.3-in (7.62-mm) machine-gun
35 Machine-gun mounting
36 Gun camera switch box
37 Crew door
38 Parachute stowage
39 Rear fuselage production break point
40 Spare coil stowage rack
41 Bombardier's side window
42 Upper turret spare ammunition magazines
43 Bombardier's folding seat
44 Gun turret mounting ring
45 Gun elevating mechanism
46 Ammunition feed chute
47 Browning 0.5-in (12.7-mm) machine-gun
48 Upper rotating gun turret
49 Bulletproof windscreen
50 Gunner's armoured seat back
51 Aerial cable
52 Port wing folded position
53 Canopy aft glazing
54 Emergency life raft stowage
55 Hydraulic reservoir
56 Radio communications equipment
57 ASB weapons aiming controller
58 Bomb release levers
59 Cabin heater duct
60 Aft end of bomb bay
61 Fixed wingroot construction
62 Wing-fold joint line
63 Browning 0.5-in (12.7-mm) fixed machine-gun
64 Ammunition feed chute
65 Ammunition magazine (320 rounds)
66 Trailing-edge flap shroud construction
67 Lattice wing ribs
68 Starboard fabric-covered aileron construction
69 Aileron hinge control
70 Aileron trim tab
71 Starboard wingtip
72 Starboard navigation light
73 Leading-edge ribs
74 Fixed leading-edge slot
75 ASB aerial
76 RT 5/APS-4 search radar pod
77 Radar mounting sway braces
78 Rocket launching pylons
79 Jettisonable fuel tank (58-US gal/219.5-litre capacity)
80 Main undercarriage wheel well
81 Sloping main spar
82 Wing-fold hinge axis
83 Twin hydraulic folding jacks
84 Machine-gun blast tube
85 Starboard main fuel tank (90 US-gal/340.7-litre capacity)
86 Centre-section main spar
87 Oxygen bottle
88 Autopilot controls
89 Rear cockpit entry hatch
90 ASB equipment rack
91 Aerial mast
92 Roll-over crash pylon
93 Second cockpit control column provision
94 Propeller de-icing fluid tank
95 Seat back armour
96 Headrest
97 Safety harness
98 Pilot's seat
99 Emergency hydraulic handpump
100 Centre main fuel tank (145-US gal/549-litre capacity)
101 Fuel tank filler cap
102 Main undercarriage retraction jack

Avenger details

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Left: In flight, the castoring tailwheel retracted out of the 'stinger' gun's field of fire . As a weight reduction measure, the ventral gun and its associated armour was removed from the TBM-3E.

Far left: A small 'Aircraft Identification' panel under the Avenger's tailplane gives details of the aircraft's 'type' (manufacturer), 'model' (USN designation) and 'serial number' (BuNo.). This panel appears on a preserved TBM-3R.

Left: Tailhook design changed during TBM-3 production. Early aircraft had a fully retractable hook, mounted internally and hinged in line with the leading edge of the tailplane. Later, an external, non-retracting hook (pictured) became standard on the TBM-3E.

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101 Fuel tank filler cap
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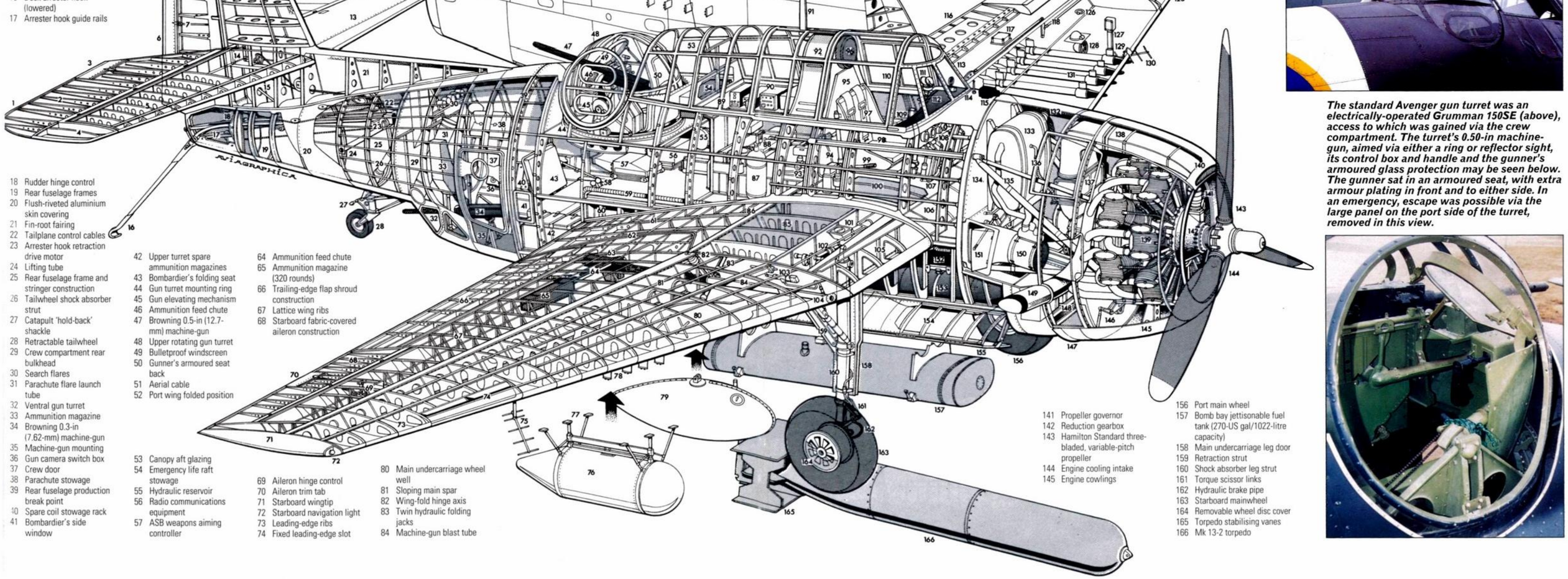
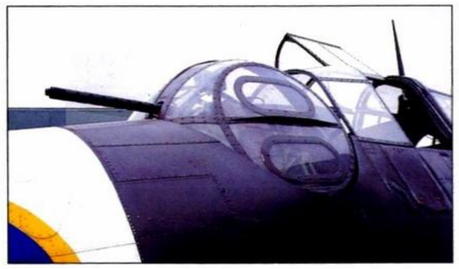
103 Wing-fold locking cylinder
104 Machine-gun muzzle
105 Centre-section leading-edge construction
106 Front fuselage frames
107 Rudder pedals
108 Back of instrument panel
109 Control column
110 Pilot's sliding entry hatch
111 Illuminated torpedo sight
112 Instrument panel shroud
113 Windscreen panels
114 Ring-and-bead gunsight
115 Gun camera
116 Port split trailing-edge flaps
117 Remote compass transmitter
118 Aileron control rods
119 Aileron hinge control
120 Fabric-covered port aileron
121 Aileron trim tab
122 Formation light
123 Pitot tube
124 Port navigation light
125 Fixed leading-edge slot
126 Wing 'tie-down' shackle
127 ASB aerial mounting
128 Retractable landing lamp
129 Red, white and green approach lights
130 Port ASB aerial
131 Ground attack rockets (5-in/12.7-cm)
132 Oil tank filler cap
133 Engine oil tank (13-US gal/49-litre capacity)
134 Engine compartment bulkhead
135 Engine mounting struts
136 Cowling air exit flap
137 Twin carburettors
138 Carburettor air trunking
139 Wright R-2600-8 Cyclone 14-cylinder two-row radial engine
140 Carburettor air intake
141 Propeller governor
142 Reduction gearbox
143 Hamilton Standard three-bladed, variable-pitch propeller
144 Engine cooling intake
145 Engine cowlings
146 Cowling air flap control lever
147 Lower cowling air flap
148 Batteries
149 Starboard exhaust pipe
150 Oil cooler
151 Oil cooler air exit flap
152 Bomb release shackle
153 Four 500-lb (227-kg) bombs
154 Bomb bay door construction
155 Bomb doors (open)
156 Port main wheel
157 Bomb bay jettisonable fuel tank (270-US gal/1022-litre capacity)
158 Main undercarriage leg door
159 Retraction strut
160 Shock absorber leg strut
161 Torque scissor links
162 Hydraulic brake pipe
163 Starboard mainwheel
164 Removable wheel disc cover
165 Torpedo stabilising vanes
166 Mk 13-2 torpedo





The standard Avenger gun turret was an electrically-operated Grumman 150SE (above), access to which was gained via the crew compartment. The turret's 0.50-in machine-gun, aimed via either a ring or reflector sight, its control box and handle and the gunner's armoured glass protection may be seen below. The gunner sat in an armoured seat, with extra armour plating in front and to either side. In an emergency, escape was possible via the large panel on the port side of the turret, removed in this view.

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151 Oil cooler air exit flap
152 Bomb release shackle
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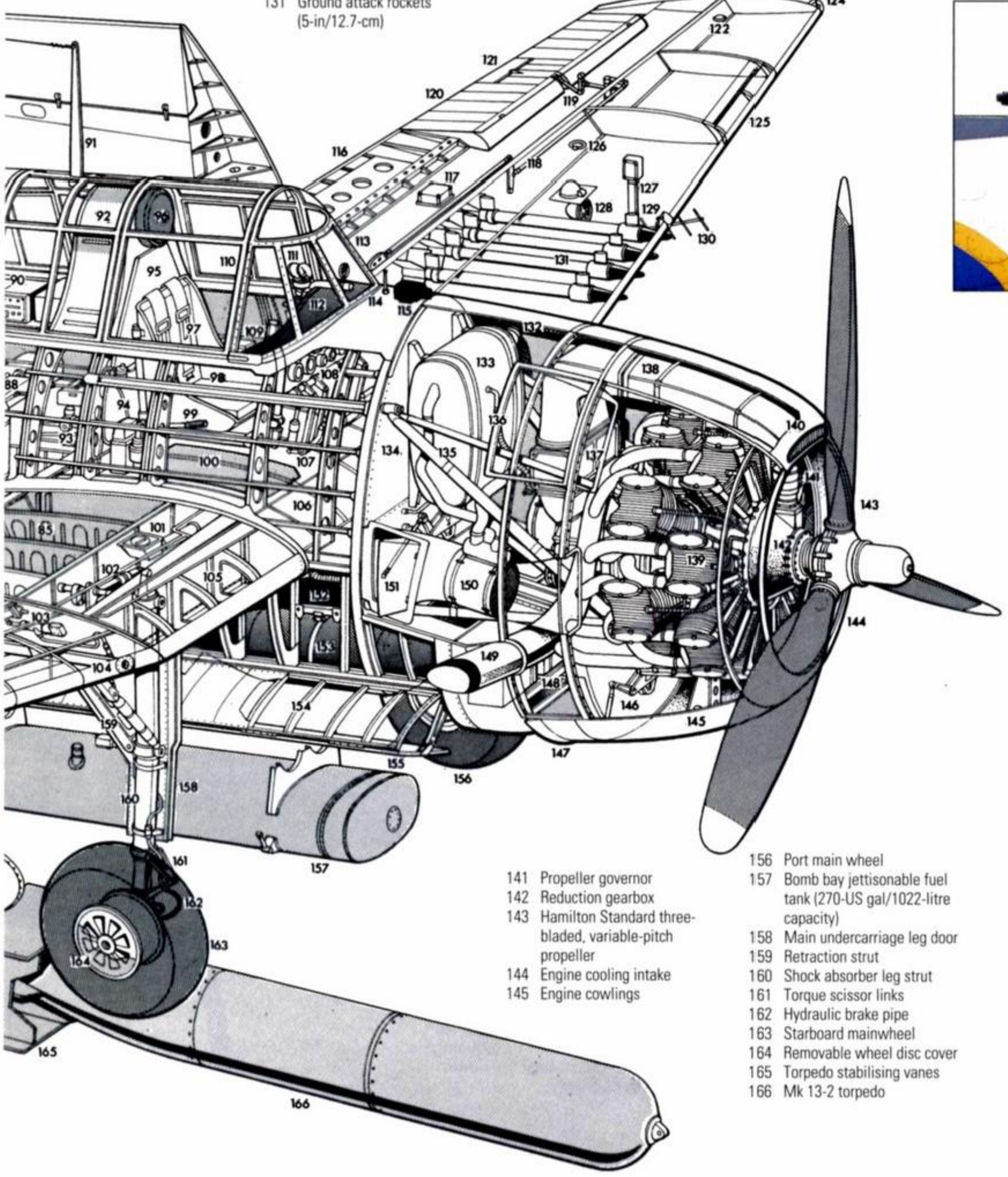
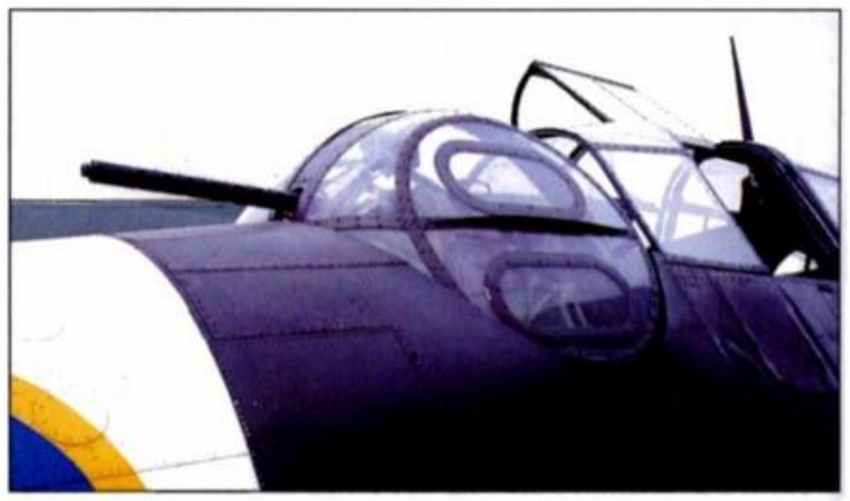
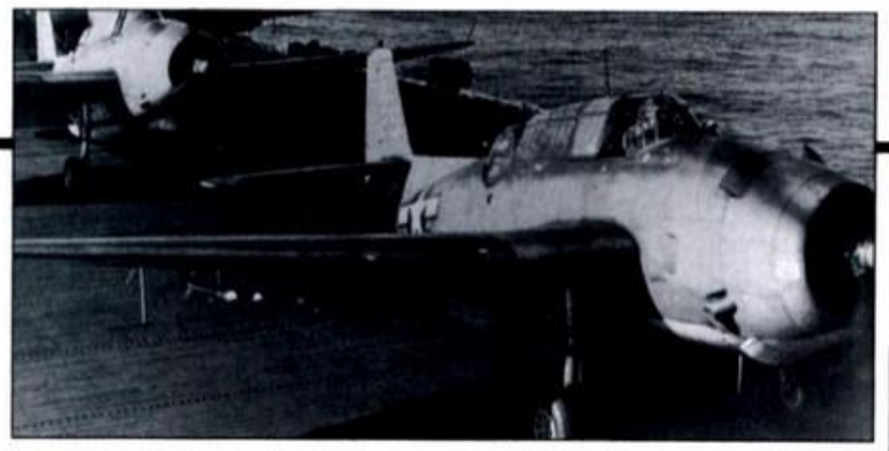
154 Bomb bay door construction
155 Bomb doors (open)



141 Propeller governor
142 Reduction gearbox
143 Hamilton Standard three-bladed, variable-pitch propeller
144 Engine cooling intake
145 Engine cowlings
156 Port main wheel
157 Bomb bay jettisonable fuel tank (270-US gal/1022-litre capacity)
158 Main undercarriage leg door
159 Retraction strut
160 Shock absorber leg strut
161 Torque scissor links
162 Hydraulic brake pipe
163 Starboard mainwheel
164 Removable wheel disc cover
165 Torpedo stabilising vanes
166 Mk 13-2 torpedo

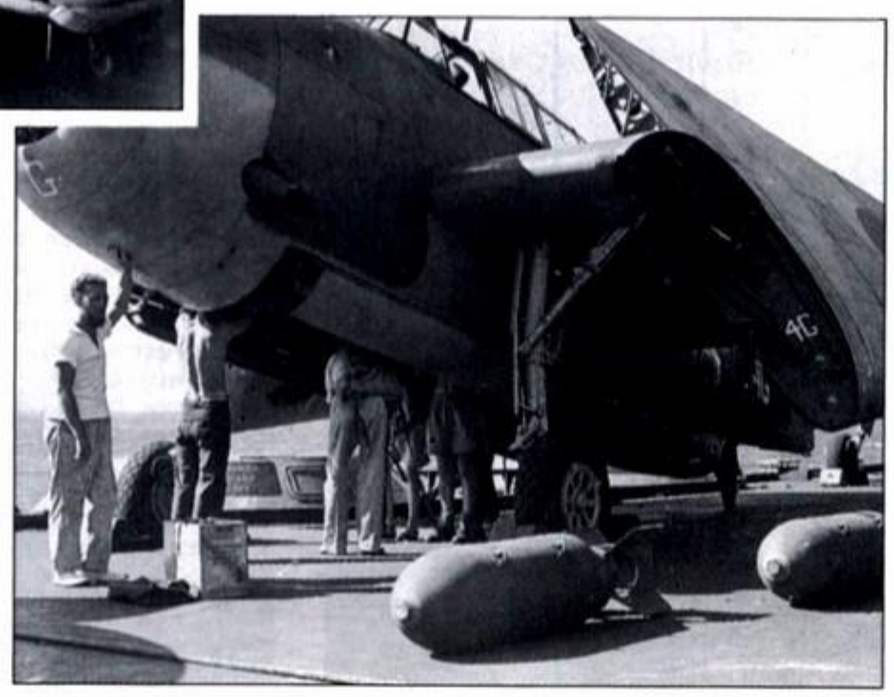


The standard Avenger gun turret was an electrically-operated Grumman 150SE (above), access to which was gained via the crew compartment. The turret's 0.50-in machine-gun, aimed via either a ring or reflector sight, its control box and handle and the gunner's armoured glass protection may be seen below. The gunner sat in an armoured seat, with extra armour plating in front and to either side. In an emergency, escape was possible via the large panel on the port side of the turret, removed in this view.



Above: This Avenger, seen off Iwo Jima in 1945, sports four 5-in (12.7-cm) aircraft rockets on zero-length launchers.

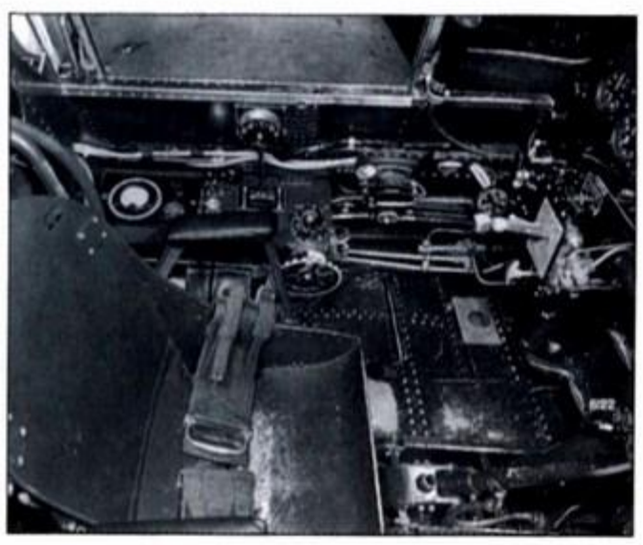
Avenger weapons



Above: USN armourers manhandle a Mk XIII 21-in (53-cm) torpedo aboard an Avenger.

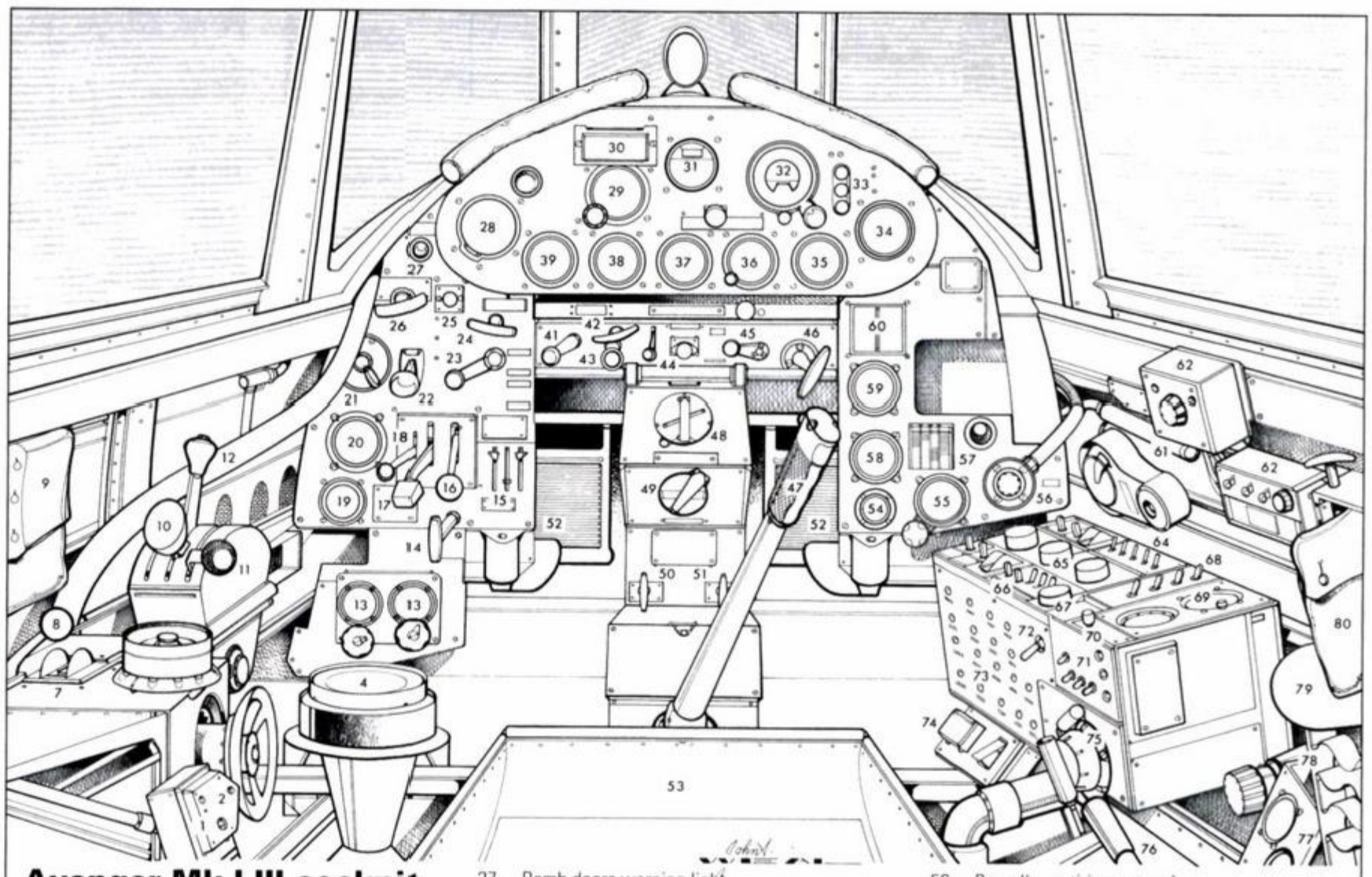
The Fleet Air Arm made little if any use of the Avenger's torpedo-carrying capability. Here, two 500-lb (227-kg) GP bombs are about to be hoisted aboard a No. 854 Sqn aircraft before a raid on Japanese positions at Surabaya, Java.

Avenger cockpit



Above: Equipment on the left side of the cockpit of the second XTBF-1 (BuNo. 2540) is seen here, including boost, throttle and mixture controls, as well as those for flap and trim settings.

The changes introduced in the layout of the Avenger's cockpit may be seen when the XTBF-1 (above) is compared with the TBM-3R (below).



Avenger Mk I-III cockpit

1 Circuit re-set button
2 Arrester hook switch
3 Elevator trimming tab control
4 Compass
5 Control quadrant friction adjustment
6 Rudder trimming tab control (aileron trimming tab control mounted on forward face of box)
7 Booster pump switch
8 Tailwheel lock
9 Map/document case
10 Throttle control lever
11 Mixture control
12 Supercharger control
13 Oxygen contents/flow gauges
14 Landing gear emergency release lever
15 Flap and undercarriage indicators
16 Flap lever
17 Undercarriage lever
18 Undercarriage locking lever
19 External air temperature gauge
20 Cylinder head temperature gauge
21 Ignition switch
22 Propeller control
23 Oil cooler shutters control
24 Emergency bomb release lever
25 ABA warning button
26 Carburettor air intake control
27 Bomb doors warning light
28 Boost gauge
29 Altimeter
30 Correction card holder
31 Directional gyro
32 Artificial horizon
33 Radio altimeter indicator lights
34 Radio altimeter
35 Radio altimeter limit switch
36 Rate of climb indicator
37 Turn and bank indicator
38 Airspeed indicator
39 RPM indicator
40 Sliding chart board
41 Cowling gill control
42 Arrester hook manual control
43 Fuel strainer drain control
44 Bomb door control lever
45 Wing folding control
46 Wing folding mechanical lock
47 Control column
48 Compass direction indicator
49 Fuel cock control
50 De-icer control
51 Cockpit heat control
52 Rudder pedals
53 Pilot's seat
54 Fuel gauge
55 Clock
56 Propeller anti-icer control
57 Data plate
58 Fuel gauge selector
59 Fuel pressure/oil temperature and pressure triple gauge
60 Take-off/ landing instructions
61 Fluorescent lighting
62 Radio control boxes (2)
63 Main electrical panel, including:
64 Lights/pitot tube heating ON/OFF switches
65 Dimmer switches (compass/chart board/ electrical panel)
66 Gun camera/armament/torpedo (smoke) bomb switches
67 Tell-tale lights switches
68 Control surface ON/OFF power switches
69 Ammeter
70 Recognition light keying switch
71 Recognition lights ON/OFF switches (white/red/green/amber)
72 Battery ON/OFF master switch
73 Circuit breaker switch panel
74 Destruct switch
75 R.1147 tuning unit
76 Hydraulic hand pump
77 Hydraulic pressure gauges
78 Signal cartridges stowage clips
79 Oxygen bottle
80 Signal pistol holster

*Left: Rocket-carrying Avenger AS.Mk 3s run up aboard **HMCS** Magnificent.*

*Right: One of Canada's eight Avenger AEWs readies for take-off from **HMCS** Magnificent.*

Canada

The Royal Canadian Navy was the third-largest Avenger operator after the US and UK, with 125 aircraft. Most were TBM-3Es and -3Ss, used in the ASW role from May 1950. The RCN designated them Avenger AS.Mk 3s in RCN service after the British fashion, with 16 being modified locally with a MAD boom to make them AS.Mk 3Ms. Others were modified as target tugs. In September 1952, eight TBM-3W2s (Avenger AEWs) were obtained. After 1957 when the bulk of aircraft were retired, many of the survivors were obtained by pest spraying and fire-bombing operations, in which roles some continue to serve today. Likewise, many of today's warbirds are former RCN aircraft.

A sonobuoy chute, a feature of the TBM-3S, can be seen in the ventral gun position of this VS-880 Avenger.

*Above: This is an **AS.Mk 3M** of **VS-880** (as No. 880 Squadron became). This modification incorporated a faired **MAD** boom on the port fuselage and **ESM** equipment under the nose.*

*Right: This **AS.Mk 3M** also served with **VS-880**. The extended 'greenhouse' top was applied to aircraft converted for target-towing, the target being housed in the MAD boom fairing on the fuselage side.*

lished, the first TBM-3Rs began flying COD missions in January 1951 while attached to Fleet Air Service Squadron Eleven (FASRON-11) at Haneda, Japan. VR-21 was formed a few months later, and a detachment soon began operating from Itazuke Air Base, which was located on the island of Kyushu, within range of the Korean Peninsula and the carriers operating in the Yellow Sea. Other detachments operated in the Philippines and Guam. In September 1951 these various detachments consolidated to form a new squadron, VR-23, which flew the bulk of the COD missions during the remainder of the Korean War.

"[It solved a problem of servicing the fleet. We consider ourselves the pioneer[s] of it," recalled Paul Brehm, one of the pilots who served in VR-23 during these formative years. The squadron operated as a miniature airline, carrying passengers, mail, copies of *Stars and Stripes*, blood plasma, aircraft parts and, in one instance, some lobster for an admiral. The pace of operations was intense, as evidenced by Brehm's logbook for the period April-July 1953. Shuttling back and forth between airfields in South Korea and Task Force 77 carriers operating in the Yellow Sea, he logged a minimum of two flights a day, with four hops being the norm rather than the exception. Some could get interesting, which is revealed in this May 1953 entry from Brehm's diary. "Took John's hop to Cherry Tree [USS *Valley Forge*] about 08.15. Weather here was good but poor at the fleet. Dove for the deck, bounced + took off + got slammed down – thought I broke a vertebra. Took off at 11.00 + got back here at 12.00 ... Finally made an approach – but the crosswind was so bad that I had to go around after almost crashing. Got down the next time ... ."

Coupled with the formation and operation of COD units in the Atlantic and California, VR-23's efforts laid the foundation for a mission that remains vital to carrier operations today. The rugged and stable Avenger filled the COD role until the twin-engined TF Trader joined the fleet in 1955.

End of an era

While many of the aircraft alongside which the Avenger had fought during World War II were put out to pasture, the rugged torpedo-bomber persevered. When the next war began in 1950, 10 front-line squadrons operated the type. However, as the decade progressed, the numbers gradually decreased as other aircraft assumed their missions. Increasingly, they found themselves in the training command or allowing 'weekend warriors' to get their flight hours at reserve air stations scattered across the United States. By the end of 1956, only five TBMs were listed in the Navy's operating inventory. The following year they were gone, their proud service to the United States over. However, it was not the end of the Avenger's days of military flying.

*Below: Retaining its US BuNo., 53682, a No. 880 Squadron Avenger **AS.Mk 3** (**TBM-3S**) patrols for submarines. The radar operator (or 'observer's mate' as they were styled at the time) can be seen facing backwards, analysing the returns from the **APS-4** pod.*

Going north

The shortest distance Avengers travelled for foreign service was across the border to Canada. In May 1950, with a great need for a carrier-based anti-submarine aircraft, the Royal Canadian Navy (RCN) struck an agreement with the US Navy to purchase TBM-3Ss. The decision marked the RCN's first major procurement of an American aircraft type, and Canadian naval aviation eventually operated 125 Avengers. In RCN service the aircraft received the designation Avenger AS.Mk 3 and Mk 3M, the latter being those examples equipped with a retractable magnetic anomaly

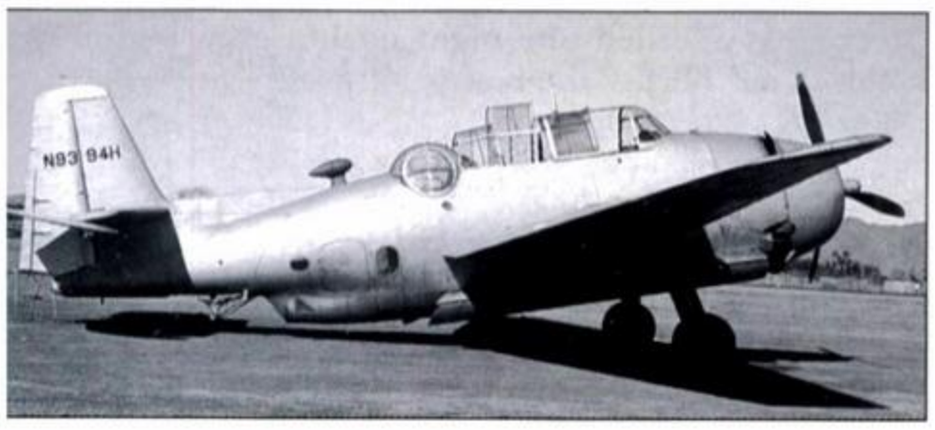
Below: RCN Avengers were put up for disposal when their careers were over. Standard aircraft were snapped up for spraying and fire-fighting, but 86175 (RCN 421), modified as a target-tug, also made it to the civil register as CF-JJB. In 1966 it was registered N68684 to Ivan Gustin of Lewiston, Indiana, but crashed in October 1967.

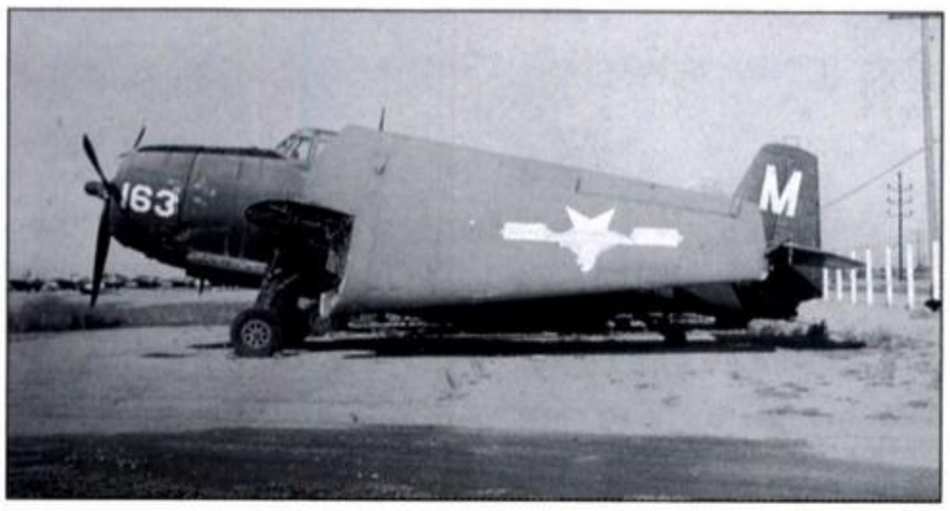
detection (MAD) boom. Additionally, some were outfitted as towing aircraft, while eight TBM-3W2s for airborne early warning were purchased in September 1952.

The first RCN pilots received training in their new aircraft directly from American naval aviators at NAS North Island, California, where VS-25 and VS-26 ushered them through 25 hours of indoctrination flights, which included live rocket firing in the California desert. Upon returning to Canada, some of these pilots from 826 Squadron provided an impressive demonstration of the new aircraft's capabilities, during November's Operation Homecoming. Logging a nine-hour flight, most of it at night, eight Mk 3s staged a mock night torpedo attack against HMCS *Magnificent* operating near Bermuda. In June 1951, 881 Squadron employed its Avengers in achieving another milestone, making the RCN's first night carrier landings since 1947. That autumn, as part of a cruise to the Mediterranean aboard *Magnificent*, squadron pilots averaged more than 110 hours of day and night flying, with each logging nearly 60 carrier landings.

During the ensuing years, the RCN engaged in a number of joint naval exercises with the navies of the United States and United Kingdom, the Avenger finally providing a comparable ASW capability. In June 1952 *Magnificent* joined HMS *Indomitable* in European waters for Exercise Castinets, which involved convoy escort and offensive ASW patrols. Avenger crews of Squadron 881 visually sighted a pair of 'enemy submarines' and obtained radar contacts on six others during the various phases of the exercise. Additionally, they logged 663 flight hours during a nine-day period, 30 per cent coming at night. September brought participation in Mainbrace, a giant NATO exercise held in the North Atlantic, which realistically simulated war conditions in the unpredictable weather of the area.

Exercise Mariner nearly brought disaster the following year, when 300 ships and approximately 1,000 aircraft from nine NATO countries came together. On 23 September 1953, while operating in the North Atlantic nearly 500





Left and far left: As with most surplus US military aircraft, hundreds – if not thousands – went into desert storage awaiting sale or scrapping. These TBM-3Es, seen in August 1957, had been bought en masse by Babb Co., which then sold the best ones. One of the fortunate aircraft was BuNo. 85886, at left. After many changes of ownership, it was restored as a warbird and flies today as part of the Avirex collection in New York.

miles (805 km) southeast of Greenland, *Magnificent* and the US carriers *Bennington* (CV-20) (forming Task Force 218) and *Wasp* (CV-18) launched a 52-aircraft strike group whose mission was to fly a couple of hundred miles distant from the ship. Reversing course, they would then make a simulated attack on the ships, which were protected by a combat air patrol (CAP). Though intended as part of this strike group, nine Squadron 881 Avengers were instead diverted to other missions, with one serving as a weather reconnaissance aircraft west of Task Force 218 and the other eight tasked with flying south of the ships to serve as 'targets' for *Bennington* as it calibrated its radar.

In the soup

Less than an hour after launch, the operating area was enveloped in fog and a wind of 30-40 kt (35-46 mph; 56-74 km/h) kicked up around the carriers. An order recalling aircraft instantly went out on the radio. Squadron 881's aircraft formed up at an altitude of 5,000 ft (1524 m) about 10 miles (16 km) from the task force, where the flight leader, Lieutenant Commander Brian Cartwright, ordered the aircraft to lighten load and reduce speed to about 100 kt (115 mph; 185 km/h). Equipped with radar, two TBMs attempted blind approaches to *Magnificent*. Lieutenant Commander 'Paddy' O'Connell, flying an AEW TBM, broke off his approach at an altitude of 60 ft (18 m) when he lost the ship on his radar, while Cartwright came close to hitting the carrier's own radar on his landing attempt "in the soup." After an order had been issued for the aircraft to fly to an area west of the task force and ditch near the US submarine *Redfin*, the fog miraculously began to lift. With the carriers formed in a line abreast cruising formation, 1,500 yd (1371 m) apart, their crews dropping flares in their wake, the aircraft came aboard one-by-one. The last aircraft to come aboard *Magnificent* were the Mk 3s flown by Lieutenants Bob Bovill and Ken Meikle, who mistakenly made an approach on the battleship *Iowa* before trapping aboard the carrier. It was the latter pilot's first night landing. That night the drinks poured aboard 'Maggie'.

During the course of the next seven years, Avengers continued to serve the RCN in both the anti-submarine and airborne early warning roles, equipping eight squadrons at the height of their service. However, they were gradually replaced by another Grumman-designed aircraft, the twin-

Below left: N9394H had once been BuNo. 46122, a TBM-1C. It was used by Paul Mantz as a camera ship when seen at Orange County in August 1957. In 1954 it had been the prototype fire-bomber with a pair of plywood tanks in the bomb bay, designed by Otto Timm. The system was crude by later standards, but opened a new career for the Avenger.

Left: One of the enduring mysteries in aviation is the disappearance of five TBMs from the VTB OTU at NAS Fort Lauderdale in December 1945. The loss of Flight 19 with 14 crewmen is the single most famous incident attributed to the so-called 'Bermuda Triangle'. On a number of occasions, such as the mid-1980s recovery here, Avenger wreckage has been found, but none of it has been proven to be from Flight 19 aircraft.

Hemet Valley Flying Services of California demonstrate fire-fighting from the air with tankers E33 and E68. Both aircraft went to Canada in 1975-76 after single-engined fire-bombers were banned in the US. E33 (N9711Z/ C-GLEH) was written off in May 1984.

Fire-bombers

TBM Inc. Sis-Q Flying services, Cisco Aircraft and Hemet Valley Flying Services were some of the many US companies to employ Avengers in the battle against forest fires. Dozens of surplus aircraft were picked up for conversion to aerial tankers or for spare parts between 1954 and the mid-1970s, when the US Forest Service insisted on multi-engined aircraft following a spate of crashes. Canada imposed no such restriction and many Avengers went north to join those already there on fire-fighting and bud worm spraying duties. Pest-spraying TBMs were also used by an Israeli firm in that country, and in Greece in the late 1960s and early 1970s.

Above: The bulldozers cut the firebreaks and the Avengers attacked the fires. An unidentified US Forest Service TBF and partner are pictured together in the 1950s or 1960s.

Below: CF-AYL was originally TBM-3, BuNo. 86091. Seen fitted with spray bars, it crashed on 17 June 1973.

An alternative (and possibly one-off) spray system used modified T-33 drop tanks as seen on N9598C.

Above: As early as 1948, entrepreneurs such as Paul Mantz were exploring commercial uses for surplus Avengers. TBF NX9394H, photographed at Phoenix complete with turret, was used for cloud seeding experiments.

Right: The aptly-named TBM Inc. operated a number of Avengers from bases at Bakersfield and, later, Tulare, California in the 1960s, including Tanker E60, N1366N, a TBM-3.

Also seen at top, tanker E68, a former TBM-3E, served as a fire-bomber from 1963, first with Hemet Valley Flying Services (with which it operated when seen at Stockton in October 1973). It crashed near Edmunston, New Brunswick on 6 August 1973 while serving with Forest Protection Ltd.

A pair of spray Avengers (TBM-3U N6829C and TBM-3E N7850C) was used by Marom Ltd of Herzelia, Israel in the 1970s. Today they are held in storage by the Israeli Air Force Museum at Hatzerim.

engined S2F Tracker. On 10 June 1960 the reliable old aircraft made its symbolic last flight at the air station at Shearwater, with Commander Hal Fearon performing a roll during a final pass over the airfield.

Across the globe

While the Avenger entered its twilight years in US Navy service, its career was only beginning abroad. Recalling its successful experience with the aircraft during World War II, the Fleet Air Arm turned to the Avenger to fill its need for an anti-submarine aircraft. A total of 100 TBM-3E (Mk 4) and TBM-3S (Mk 5) versions was delivered to the United Kingdom from 1953. The Mk 5 was modified to carry a radome beneath the bomb bay. Five front-line and three Reserve squadrons flew the aircraft before it was retired for good in 1962.

Across the English Channel, the Aéronautique Navale benefited from the service of the Avenger, operating four versions during 1951-1966. This included service aboard the carriers *Arromanches*, *Bois Belleau* and *Lafayette*. The latter two carriers were the former US Navy light carriers *Belleau Wood* (CVL-24) and *Langley* (CVL-27), respectively, whose decks had handled many an Avenger during World War II. By at least one account, the French pilots already knew their way around the ship. Toby Tobin, a US Navy landing signal officer (LSO) on exchange duty with the French navy, called one night qualification period that involved six TBMs "the best night quals I've ever seen or heard of!" Operating as part of NATO exercises, French Avengers flew hunter-killer ASW missions and AEW hops. Some supported the Anglo-French operation against Egypt in the October-November 1956 Suez Crisis. Five TBM-3S/3Ws from *Arromanches* joined two Avengers from the British light carrier *Bulwark*, the latter among the last delivered to the FAA, in barrier patrols around the carriers to warn of incoming Egyptian air attacks. None materialised.

Forest Protection Limited

In the late 1990s, one operator in Canada still maintains a fleet of Avengers for forest-fire fighting and bud worm spraying. The aircraft, mostly ex-RCN (see table), belong to Forest Protection Ltd and are contracted to the New Brunswick Department of Natural Resources and Energy (DNRE). Based at Miramichi Airport, the aircraft average 75 hours per year in the fire season between 1 May and 15 September. The DNRE is extremely happy with the TBMs and so far no equivalent replacement has been found.

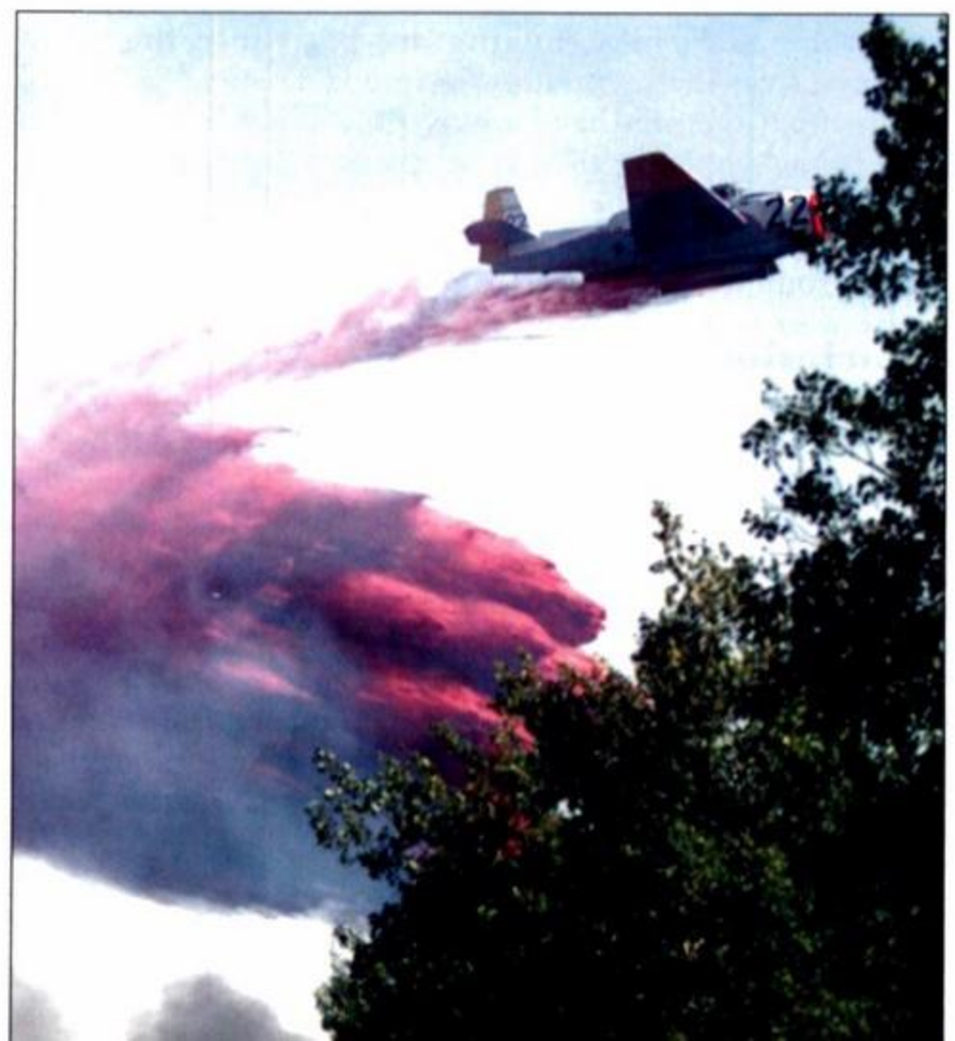
Above: Tanker 13 launches a load of retardant at the photographer during fire-fighting operations in July 1998. The fire bombing tanks and related controls were designed by Conair Aviation and are capable of 'full salvos', 'single doors' and 'string drops'. The tanks can contain up to 500 Imp gal (2273 litres) of long-term retardant or foam.

The Netherlands received a number of surplus Avengers from the United States and United Kingdom. Seventy-eight TBM-3E, TBM-3S, and TBM-3W2 versions joined the Marine Luchtvaart Dienst between 1953 and 1958, serving as ASW aircraft and in the utility role. The fifth navy to take the Avenger to sea, the Dutch operated them aboard the carrier HrMs *Karel Doorman*.

Three other nations on opposite sides of the Pacific completed the foreign service of the Avenger. In South America, Brazil and Uruguay operated 25 examples between them during the 1960s, with the former nation employing them in carrier qualifications aboard the light carrier *Minas Gerais* in June 1960. Ironically, Japan, the nation whose attack on Pearl Harbor on 7 December 1941 had inspired the TBF/TBM's name, made the torpedo-bomber the first combat aircraft to equip its Maritime Self-Defence Force. Taking delivery of 10 TBM-3W2s and 10 TBM-3Ss during 1954-1955, Japan operated the type in the ASW role until 1962.

New enemies

Like other aircraft of its generation, the Avenger's flying days did not end when it left military service. The same ruggedness and load-carrying capability that had made them successful torpedo-bombers proved ideal for fighting a new enemy: forest fires. From 1954, companies in the American west and the US Forestry Service began operating surplus TBMs as aerial tankers. In most cases converted to single-seaters, the aircraft also received extensive modifications to their bomb bays enabling them to carry heavy loads of fire retardant. A series of accidents, including seven involving TBMs, prompted most US companies to switch to multi-engined aircraft in the early 1970s. Even more mishaps occurred in Canada, but some Avengers still fly as fire-fighters there: six TBMs operate under contract to the Department of Natural Resources and Energy in New Brunswick. Carrying advanced tanks that allow the pilot to either drop the entire load of foam or retardant chemicals at once, split it in half for a pair of runs, or release two loads seconds apart, the former warbirds are a valuable part of the



Although the FPL Avengers may be over 50 now, their 'bombing' runs are aided by some very new technology such as global positioning satellite (GPS) receivers. It is still a dangerous game, however – tanker 14 (C-GLEK, ex-BuNo. 85733 and N6824C) crashed into trees on 16 August 1998 following engine failure. The pilot, Robert Le Blanc, walked away without a scratch, but the TBM was destroyed.

The last Avenger fire-bombers

In the late summer of 1998, FPL operated six TBM tankers, with five spraying aircraft in storage awaiting the next spruce bud worm outbreak, as follows:

	no.	civil reg'n	to FPL	BuNo.	RCN serial	first civil reg'n
Tankers	3	C-GFPS	1976	85460	RCN 346	N7032C
	13	C-GLEL	1974	53200	RCN 377	N9010C
	21	C-GFPM	1975	53857		
	22	C-GFPL	1976	86020	RCN 327	
	23	C-FIMR	1976	83610	RCN 303	
	24	C-GLEJ	1974	69323		
Sprayers	4	C-GFPR	1976	53858		N3357G
	10	C-GFPT	1976	53787		N3969A
	12	C-FMUD	1977	86180	RCN 324	
	17	C-GFPN	1976	91289		
	18	C-FMUE	1977	91426	RCAF	

Right: BuNo. 8574/N7001C is a genuine combat veteran, having flown off Yorktown in 1945 with VT-88. It is owned by Richard Ervin of Indianapolis.

Warbirds

The Avenger has proved a reliable, practical and safe warbird. Most of the dozen or so aircraft currently flying in the US, and the many others under restoration, are former fire-bombers and sprayers, and almost all are TBM-3s or variants. Other aircraft fly in the UK, France, Canada and New Zealand.

Above: Illustrated earlier, TBM-3E BuNo. 85886 now flies as an aircraft of VS-22, and is based at Tenalfy, New York.

Right: This aircraft, BuNo. 53835 with spurious 'GS' codes, is a TBM-3U. It is owned by Skarda Flying Services of Hagen, Arizona

Once probably considered beyond hope, aircraft in worse shape than this are now considered to be challenging restoration projects. N5264V (BuNo. 53353), seen in 1978 at Warb's Trailer Park, Jacksonville, is flying today with Wiley Sanders of Troy, Alabama.

Above: Formerly a fire-bomber and crop-sprayer, TBM-3E N6827C flew with the Old Flying Machine Company from 1988-92.

Left: Didier Chable's F-AZJA, another TBM-3E, wears a similar FAA scheme.

Tony Haig-Thomas is the owner of TBM-3R G-BTDP, restored in original configuration and based at North Weald.

team that tackles forest fires during the spring and summer.

Although most TBMs flew as tankers in the civilian world, some became crop-dusters, hugging farmers' fields much as they had the wave tops on a torpedo run. One Avenger even flew in the US Cup Races in July 1971, ironic for an aircraft that was never known for its speed.

The former N6827C is now part of the Alpine Fighter Collection at Wanaka, New Zealand, registered ZK-TBM and painted in wartime RNZAF colours. Relatively economical, manoeuvrable and speedy, the TBF/TBM is popular with air show audiences and operators alike. The future of the Avenger as a warbird seems secure, with examples expected to fly well into the next century.

Lost and found

Nearly 100 examples of the TBF/TBM Avenger survive today. Most have made their ways to museums scattered throughout the United States and other areas of the globe from New Zealand to the United Kingdom to Israel. A few have been restored to flying condition, the roar of their engines speaking to new generations at air shows. Many have been found, but it is certain that there will be people searching in hopes of adding to this total, especially off the coast of Florida – for the Avenger will always be associated with one of the greatest mysteries of our time.

A little after two o'clock on the afternoon of 5 December 1945, a flight of five Avengers departed NAS Ft Lauderdale, Florida on a routine training flight. Flight 19 climbed into skies with visibility of between 10 and 12 miles (16 and 19 km), lessening slightly within the rain showers that were present in the track of the navigational problem the aircraft were executing. A wind with gusts up to 31 kt (36 mph; 57 km/h) made the seas moderate to rough as the quintet of torpedo-bombers left the Florida coast behind them. Almost two hours after Flight 19 departed, an instructor in the air over the field at Ft Lauderdale intercepted a radio transmission in which the instructor leading Flight 19 indicated he was lost. Over the course of the next three hours, garbled voices could be heard over the airwaves, their tones indicating increasing confusion among the pilots. Eventually these voices fell silent. In all likelihood the aircraft were forced to ditch in rough seas with their fuel tanks running dry but, since the event occurred over the mysterious 'Bermuda Triangle', a host of supernatural theories have arisen. One thing is certain: no trace of the aircraft or their crews has ever been found.

Others are out there still, scattered along the ocean bottoms of the Atlantic and Pacific, or hidden in the jungles somewhere, waiting to be found.

Conclusion

The career of the TBF/TBM Avenger was one marked by irony. Born to deliver torpedoes against enemy warships, its primary mission had all but disappeared by the end of World War II. A relatively slow and lumbering aircraft with the uninspiring moniker of 'Turkey', it was overshadowed by the flashier fighters and dive-bombers of World War II. Yet, while many of its more famous counterparts dropped from the scene after the guns fell silent, the Avenger soldiered into the atomic age on the front lines of the Cold War. It was a aircraft that did many things well, and one whose versatility proved to be its greatest asset. The result is a proud legacy.

Avenger Operators

United States of America

United States Navy

Torpedo Squadrons

The United States Navy established its first Torpedo Plane Squadron in 1921, a year before the first fighter squadron and seven years before the first dive-bombing unit joined the fleet. The following year the nomenclature for the VT designation changed to Torpedo & Bombing Plane Squadron or Torpedo & Bombing Squadron, which lasted until 1930, at which time it became Torpedo Squadron. The floatplanes that filled the ranks of these early VT squadrons laid the foundation for the mission, launching a mass torpedo attack against the battleship USS *Arkansas* (BB-33) on 27 September 1922 in demonstration of the capabilities of this method of warfare.

The first torpedo squadron to be assigned to an aircraft-carrier was VT-2B, which joined the US Navy's first flat-top, USS *Langley* (CV-1) in 1927. Fourteen years later, on the eve of the Japanese attack on Pearl Harbor and the entry of the United States into World War II, there were six carrier-based torpedo squadrons.

The early battles of World War II demonstrated that the TBD Devastator, the US Navy's front-line aircraft, was technologically past its time. Luckily, the US Navy had contracted with Grumman for a more advanced torpedo-bomber, the TBF Avenger, which joined the fleet in April 1942. Ironically, the squadron whose sacrifice at the Battle of Midway would do more than anything else to signify the twilight of the Devastator would also introduce the new Avenger.

The first version of the Avenger to join the fleet was the TBF-1, which participated in three of the four carrier battles between the US Navy and the Imperial Japanese Navy that occurred during 1942 – Midway, Eastern Solomons, and Santa Cruz. By September-October 1943, when the first TBF-1Cs (increased armament and fuel capacity) reached the fleet, the number of torpedo squadrons had reached 15. With the new 'Essex'-class carriers having entered combat in August and many more under construction in American shipyards, the numbers could only get higher.

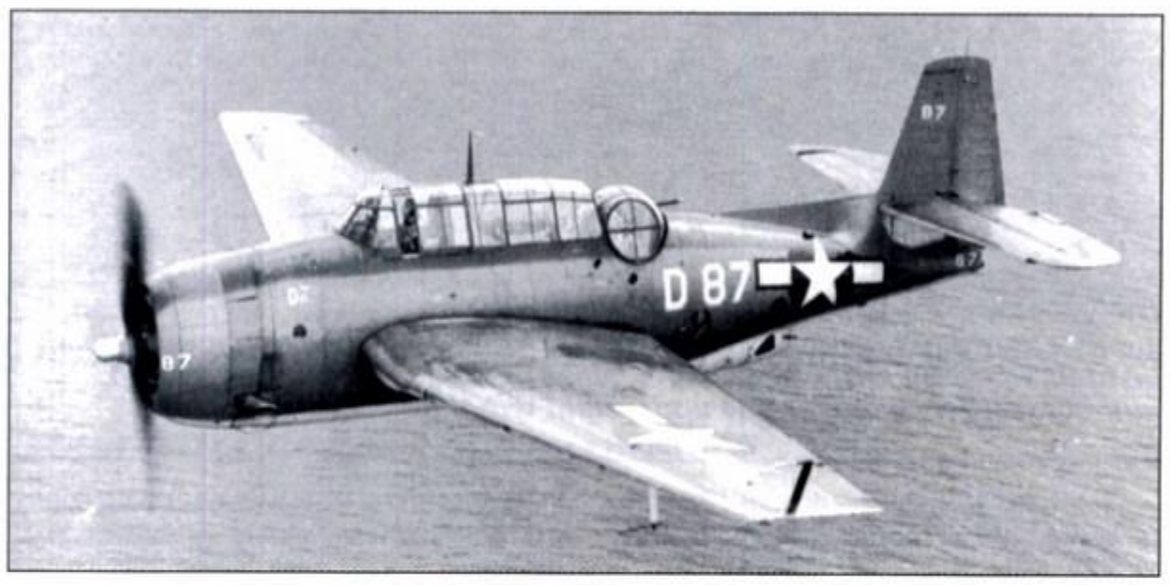
Within weeks of the arrival of the TBF-1C in the Navy's torpedo squadrons, the first of the Eastern-built TBM-1s made their appearance with VT-11, VT-18 and VT-19, all recently established or reforming squadrons based on the West Coast. As the war progressed and an increasing number of Avengers rolled off the Eastern assembly lines, the TBFs would become increasingly rare in VT squadrons. Variants of the TBM-1 and TBM-3, the latter appearing in torpedo squadron aircraft complements from July 1944, would equip all 66 torpedo squadrons active at the time the atomic bombs fell on Hiroshima and Nagasaki.

Although commanders in the early months of World War II devoted the Avenger almost exclusively to torpedo attack, the inherent versatility of the aircraft and the changing face of the war brought varied missions. VT pilots found themselves dropping fewer torpedoes and instead logging glide bombing and rocket attacks, and even flying primitive radar countermeasures and airborne early warning missions. Additionally, 10 designated night torpedo squadrons pioneered nocturnal attack in naval aviation. The decline of the VT mission foreshadowed the post-war introduction of a single type capable of handling the missions once divided between bombing and torpedo aircraft.

With a few exceptions – notably VT-305 and its participation in hammering Rabaul in the South Pacific – most VT squadrons flew their combat missions from the decks of fleet aircraft-carriers. The arrival of the kamikazes in autumn 1944 necessitated the inclusion of more fighters in the aircraft complements of carrier air groups, but the number of Avengers aboard ship only slightly declined. As an example, USS *Essex* (CV-9) carried 18 TBF-1 Avengers of VT-9 when it launched its first combat strike of the war against Marcus Island on 30 August 1943. Operating off the coast of Japan in July 1945, it carried 15 TBM-1C/3/3E Avengers of VT-83. The torpedo aircraft complement of the air groups operating from the light carriers of the 'Independence' class did not change at all, remaining at nine throughout the war.

All told, 87 torpedo squadrons flew Avengers during World War II, among them 10 night torpedo squadrons.

In this rare colour view, an early production TBF-1 of VT-2 is seen in mid-1944. Note the unit badge in front of the cockpit and the two-figure individual aircraft code on the tailfin.



Above: This TBM-3 of VT-40, seen on 27 April 1945, may be identified by its 'D' fuselage code as flying from CVE-27 USS Suwanee.

Below: VT-83's TBM-3Es, along with the rest of those aircraft aboard USS Essex (CV-9), carried this distinctive triangular marking on their tailfins and the upper surface of the starboard wing. This aircraft, named Satan's Helper, has an APS-4 radar and is seen off Okinawa in 1945.

Below: 'RR' was the code worn by VT-88's TBM-3s aboard USS Yorktown in August 1945. Note the glossy sea blue (so-called 'midnight blue') aircraft in the centre of the formation. Glossy sea blue was introduced for all carrier-based aircraft in October 1944, replacing the Basic (Non-Specular) scheme.

Night Torpedo Squadrons

VT(N)-41, VT(N)-42, VT(N)-43, VT(N)-52, VT(N)-53, VT(N)-54, VT(N)-55, VT(N)-63, VT(N)-90, VT(N)-91

Composite Squadrons

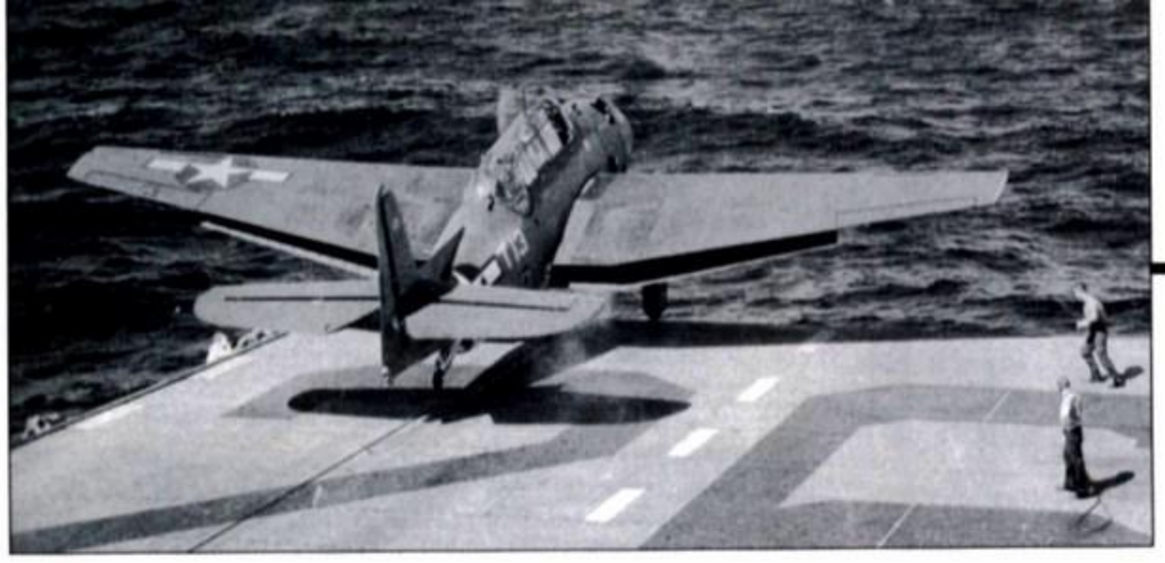
In October 1940 President Franklin D. Roosevelt introduced a new class of flat-top when he directed the Chief of Naval Operations to convert a merchantman to a small carrier. With this impetus directly from the Oval Office, the Navy in short order began conversion on what would become USS *Long Island* (AVG-1), commissioned on 2 June 1941. It was the first of 114 escort carriers of six classes built during World War II. With the arrival of these 'baby flat-tops' came the necessity for a new type of squadron, small enough to operate from carriers of limited size, yet versatile enough to tackle a variety of missions. The result was the VGF (Escort-Fighter Squadron) and VGS (Escort-Scouting Squadron), which were both established in 1942. Initially, VGSs were equipped with a mixture of SBD Dauntless dive-bombers and TBF Avengers. However, in short order the Grumman torpedo-bombers came to be the weapon of choice, eventually equipping 15 VGS outfits, including VGS-27 and VGS-29, which participated in Operation Torch, the invasion of North Africa.

In 1943 the Navy adopted a new squadron designation which combined the VGF/VGS designations into one. Appropriately called Composite Squadrons (VC) because they combined aircraft of different type and missions, these units generally consisted of a mixture of nine F4F/FM Wildcats and 12 TBF/TBM Avengers when operating from escort carriers, though these figures varied throughout the war. In addition, in their formative stages, VT squadrons often began life as VC squadrons until enough pilots were onboard for the squadron to be redesignated to reflect its particular speciality. VGS/VC squadrons operated TBF-1s until autumn 1943, at which time the first TBF-1Cs appeared in the squadrons. The ensuing months brought TBM-1/1C/1D aircraft, with the TBM-3 arriving in autumn 1944. At war's end the VC squadrons, most of which were in the Pacific, operated a mix of Avengers. As an example, one squadron based at San Diego, VC-78, had two TBF-1s, one TBM-1C, one TBM-3, and eight TBM-3Es in its hangar.

Nowhere was the versatility of the TBF/TBM Avenger demonstrated more than in the ranks of the Navy's VC squadrons and their VGS predecessors. In the Atlantic they hunted U-boats and supported the first Allied offensive of the war in that particular theatre. In the Pacific they perfected close air support, flew aerial spotting missions, and interdicted the battlefield on many islands. Additionally, confronted with overwhelming odds, they hammered the Japanese Center Force at Leyte Gulf, blunting the Imperial Japanese Navy's last offensive action of the war.

VGS-1, VGS-9, VGS-11, VGS-12, VGS-13, VGS-16, VGS-18, VGS-20, VGS-21, VGS-23, VGS-25, VGS-26, VGS-27, VGS-28, VGS-29
(All redesignated VC on 1 March 1943)

VC-1, VC-2, VC-3, VC-4, VC-5, VC-6, VC-7, VC-8, VC-9, VC-10, VC-11, VC-12*, VC-13, VC-14, VC-15, VC-16, VC-17, VC-18, VC-19, VC-20, VC-21, VC-22*, VC-23*, VC-24, VC-25*, VC-26*, VC-27, VC-28*, VC-29*, VC-30*, VC-31*, VC-32*, VC-33, VC-34, VC-35*, VC-36, VC-37*, VC-38*, VC-39, VC-40*, VC-41, VC-42, VC-43, VC-50*, VC-51*, VC-52, VC-55, VC-58, VC-60*, VC-63, VC-64, VC-65, VC-66, VC-68, VC-69, VC-75, VC-76, VC-77, VC-78, VC-79, VC-80, VC-81, VC-82, VC-83, VC-84, VC-85, VC-86, VC-87, VC-88, VC-89,



TBF-1 'T13' of VC-30 launches from USS* Monterey *in 1943.

***Right: The pilot, Ensign Gallo, makes his escape from TBM-1 'AA21' after ditching on 2 March 1944 from USS* Tulagi.**

VC-90, VC-91, VC-92, VC-93, VC-94, VC-95, VC-96, VC-97, VC-98, VC-99
(*indicates eventual redesignation as VT)

Following World War II the VC designation disappeared briefly from the rolls of naval aviation, only to be reintroduced in 1948. In the post-war years, however, VC squadrons were divided into distinct missions, including anti-submarine warfare, all-weather, night operations, attack and defence, airborne early warning and photographic reconnaissance. Nearly every version of the Avenger served in this VC reincarnation, the aircraft ideally suited to a variety of missions.

VCN-1 (Night Composite Squadron One), VCN-2, VC-3, VC-4, VC-10, VC-11, VC-12, VC-21, VC-22, VC-23, VC-24, VC-25, VC-31, VC-32, VC-33, VC-35, VC-50, VC-90, VC-110, VC-130, VC-170, VC-210

Utility Squadrons

Flying in the service of utility squadrons (VJ) during World War II, Avengers logged a variety of missions from towing targets to running torpedo chase for submarines. Throughout the war years, TBF/TBM aircraft could be found on utility duty nearly everywhere naval forces operated, from Pacific island bases to air stations in the continental United States.

VJ-1, VJ-2, VJ-3, VJ-4, VJ-5, VJ-6, VJ-7, VJ-9, VJ-10 VJ-12, VJ-13, VJ-14, VJ-15, VJ-16, VJ-17, VJ-18

Seven of these utility squadrons continued to fly the Avenger into the post-war years. In 1946 the Navy designation for utility squadron changed from VJ to VU. In this guise, the following squadrons had TBM-3Us in their inventory.

VU-1, VU-2, VU-4, VU-5, VU-7, VU-10

'UA' tailcodes indicate an aircraft of utility squadron VU-1. Aircraft '11' (BuNo. 91206) was a TBM-3U and carries the high-visibility colour scheme applied to utility types, consisting of chrome yellow wing surfaces, with an insignia red wing stripe and rudder. Note that the tailcode and aircraft number were repeated on the upper right wing.

Miscellaneous squadrons

Numerous other squadrons and commands of various types operated small numbers of Avengers during World War II. Most CASUs (Carrier Aircraft Service Units) had at least one in their inventory at any given time, as did various CACs (Commander, Air Centers) on the islands in the Pacific, and Fleet Air Wings.

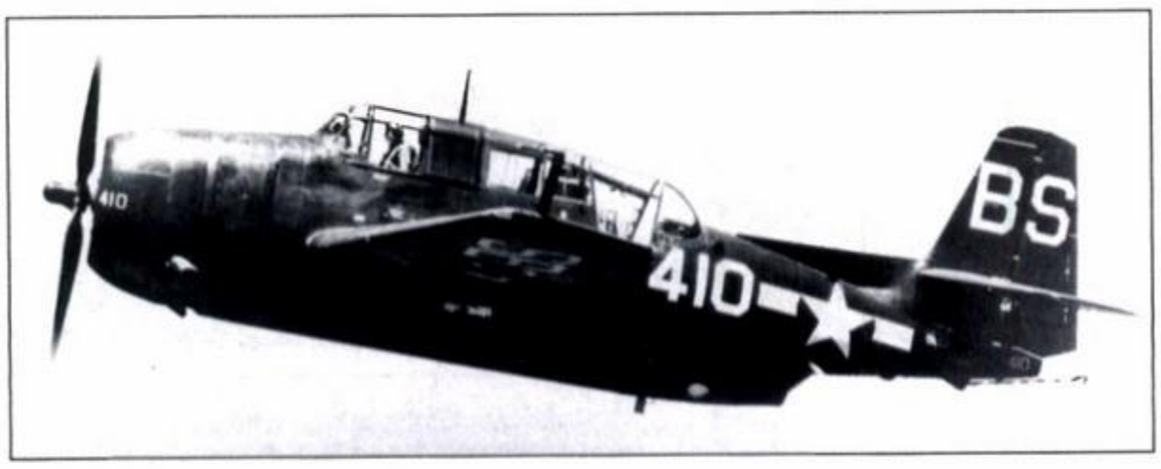
A few units/commands warrant mention. STAG-1 (Special Task Air Group One), whose squadrons were devoted to developing tactics for employment of assault drones, essentially early guided missiles, operated a peak of 19 TBF/TBMs in April 1944. Not surprising given the Avenger's prominent role in the development of night operations, NACTU (Night Aircraft-carrier Training Unit) Atlantic and Pacific were equipped with the aircraft, as were a number of night-fighter squadrons in their formative stages. The command devoted to training the masses of carrier aviators during the war, namely the Carrier Qualification Training Unit (CQTU) at NAS Glenview, Illinois, sent many aircraft over Lake Michigan for flight operations aboard the training carriers *Wolverine* (IX-64) and *Sable* (IX-81). One TBF-1 that crashed into the lake has been recovered by the National Museum of Naval Aviation in Pensacola, Florida, with its Walt Disney-designed insignia still visible on the cowling Finally, land-based scouting squadrons (VS-22, VS-23, VS-24, VS-67) devoted to inshore patrol and photographic squadrons (VD-1 and VD-2) employed the Avenger during the war years.

Antisubmarine Squadrons

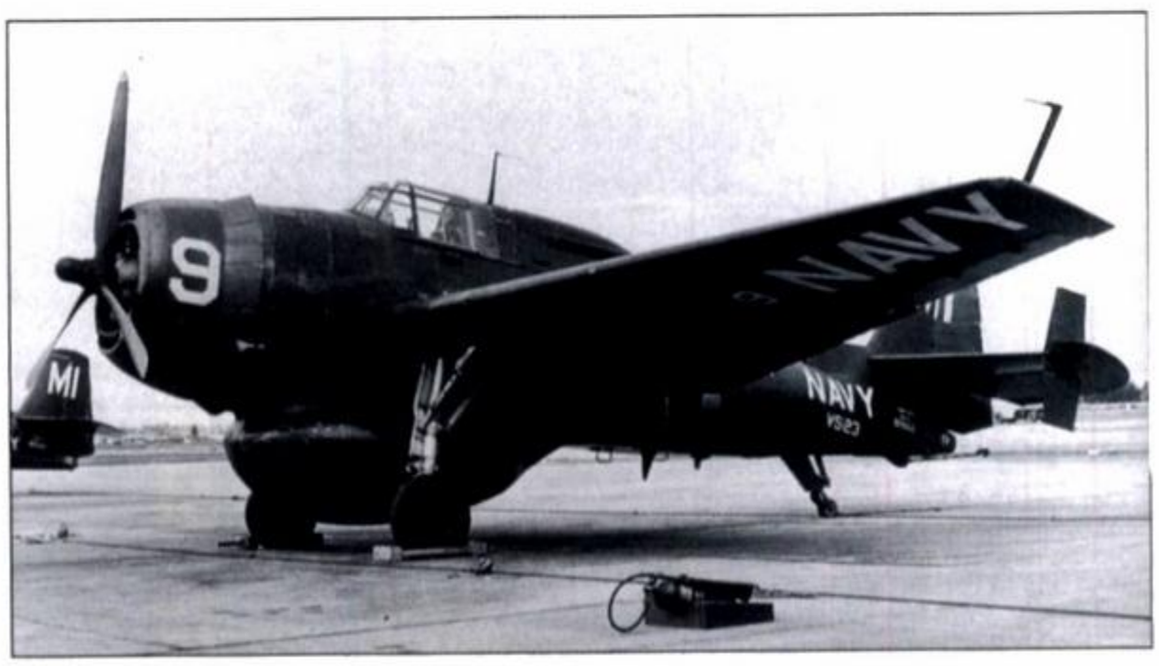
Given the success of carrier-based anti-submarine warfare during World War II, it is not surprising that the US Navy created squadrons devoted exclusively to this mission. In spring 1950, the first of the VS (Antisubmarine Squadron or Air Antisubmarine Squadron) units appeared in the fleet. Many were formed from existing VC squadrons devoted to ASW, which, not surprisingly, were equipped with a variety of versions of the TBM. Thus, the aircraft that ushered in the era of ASW from carrier decks became the first to equip the maiden squadrons devoted exclusively to that mission. Until their Avengers were totally supplanted by the AF Guardian, the VS squadrons operated TBM-3E, TBM-3S, TBM-3W, TBM-3Q, TBM-3S2, and TBM-3W versions of the aircraft, predominantly from light and escort carriers.

VS-21, VS-22, VS-23, VS-24, VS-25, VS-26, VS-27, VS-31, VS-32, VS-36, VS-37, VS-38, VS-39, VS-801*, VS-831*, VS-871*, VS-892*, VS-913*, VS-931*

(* indicates Naval Air Reserve squadron called to active duty during the Korean War)



Above: Anti-submarine TBM-3S BuNo. 91152 carries the codes of VS-2, based at San Diego in 1950.



Right: In 1950, VS-23 (formerly VC-23) operated TBM-3W2s with 'MI' codes.

'RK' tailcodes indicate an aircraft of Fleet Logistic Air Squadron 23. This TBM-3R, BuNo. 85905, sports a large unit badge forward of the cockpit .

Fleet Logistics Air Squadrons

The aircraft that pioneered the carrier onboard delivery (COD) mission, TBM-3Rs equipped the Navy's first Fleet Logistic Air Squadrons (VR), operating in detachments around the globe wherever US carriers were on station.

VR-5, VR-21, VR-22, VR-23, VR-24, VR-25

Attack Squadrons

In 1946 the US Navy combined the traditional missions of bombing and attack into one, creating the Attack Squadron (VA). Following so closely on the heels of World War II, it is not surprising that many of these new units were redesignated VT and VB squadrons fresh from wartime service, complete with TBM Avengers and SB2C Helldivers. Serving aboard all classes of carriers, including the new battle carriers (CVB) *Midway*, *Franklin D. Roosevelt* and *Coral Sea*, these warbirds equipped the newly established VA units until they were phased out in favour of the AD Skyraider, the US Navy's first attack aircraft. The VAs operated a mix of TBM-3E/3J/3S/3Q/3W aircraft, and some of the units were devoted to anti-submarine warfare and airborne early warning, since specialised squadrons dedicated to these particular missions were still in the future.

VA-1E*, VA-1L*, VA-2A/VA-15*, VA-2B/second VA-65*, VA-2E, VA-3E, VA-4A/first VA-35*, VA-4B/VA-45*, VA-6A/first VA-55*, VA-8A/first VA-75*, VA-84, VA-10A/first VA-95*, VA-12A/first VA-115*, VA-14A/first VA-135*, VA-16A/first VA-155*, VA-18A/first VA-175*, VA-20A*, VA-22A*, VA-25, VA-55E (Reserve squadron at NAS St. Louis), VA-71E (Reserve squadron NAS Glenview), VA-213, VA-214, VA-702 (Reserve squadron at NAS Dallas), VA-859 (Reserve squadron at NAS Niagara Falls that operated TBM-3Es before Korean War recall)

(* indicates redesignated VT squadron)

These TBM-3Es, seen in 1947 while assigned to VA-2A (later VA-15), display distinctive tail markings combining a two-figure aircraft number with a carrier air group identity letter – in this case, 'T' for CVG-1.

TBM-3W BuNo. 69676 served with VX-1 (tailcode 'XA'), from NAS Boca Chica, Florida in January 1950.

Fleet Aircraft Service Squadrons

Created in 1946, FASRONs supported front-line squadrons, providing maintenance on their aircraft. Thus, while the Avenger was in operation, at least one example appeared on the inventory of FASRONs of the Atlantic and Pacific Fleets at any given time.

FASRON 1, FASRON 2, FASRON 3, FASRON 4, FASRON 5, FASRON 6, FASRON 7, FASRON 8, FASRON 9, FASRON 10, FASRON 11, FASRON 12, FASRON 51, FASRON 52, FASRON 77, FASRON 108, FASRON 112, FASRON 113, FASRON 117, FASRON 118, FASRON 120

Training Command

Like many tired warbirds in the twilight of their career, the Avenger found its way to the Naval Air Training Command, where it served as an advanced trainer for prospective attack pilots, as well as an aircraft in which many a flight student in the early 1950s logged his first trap aboard an aircraft-carrier. Additionally, Reserve units scattered at air stations throughout the country were equipped with the aircraft. Overall, a great number of the TBM-3Es procured by the Navy ended their service lives in the training command. Specialised fleet training units also employed the aircraft, including the TBM-3N and -3W.

ATU-1 (Advanced Training Unit One), NAS Banana River, Florida; ATU-5, NAS Jacksonville, Florida and NAAS Cabaniss Field, Texas; ATU-6, NAS Corpus Christi, Texas; ATU-7, NAAS Whiting Field, Florida; ATU-400, NAAS Kingsville, Texas; CQTU-4 (Carrier Qualification Training Unit Four), NAAS Barin Field, Alabama; Fleet All Weather Training Unit, Atlantic; Fleet All Weather Training Unit, Pacific; Fleet Airborne Electronics Training Unit, Atlantic; Fleet Airborne Electronics Training Unit, Pacific; Combat Information Center Officer School, NAS Glenview, Illinois; Squadron Commanders School, NAS Jacksonville, Florida

FALLWEATRAPAC (Fleet All Weather Training Unit, Pacific) was among the Training Command units equipped with TBM-3Ns, this example of which is seen off the coast of Oahu, Hawaii in about 1950. Note the modified cockpit of the type fitted to the TBM-3S .

Reserve units

Reserve Units at the following air stations flew various versions of the Avenger:

NAS Akron, Ohio, NAS Anacostia, District of Columbia, NAS Atlanta, Georgia, NAS Birmingham, Alabama, NAS Columbus, Ohio, NAS Dallas, Texas, NAS Denver, Colorado, NAS Glenview, Illinois, NAS Gross Ile, Michigan, NAS Jacksonville, Florida, NAS Lincoln, Nebraska, NAS Los Alamitos, California, NAS Memphis, Tennessee, NAS Miami, Florida, NAS Minneapolis, Minnesota, NAS New Orleans, Louisiana, NAS New York, New York, NAS Niagara Falls, New York, NAS Norfolk, Virginia, NAS Oakland, California, NAS Olathe, Kansas, NAS Seattle, Washington, NAS Spokane, Washington, NAS Squantum, Massachusetts, NAS St Louis, Missouri, NAS Willow Grove, Pennsylvania

Carrier Airborne Early Warning Squadrons

On 6 July 1948 the Navy established a single Carrier Airborne Early Warning Squadron (VAW) on each coast with the responsibility for organising and training Airborne Early Warning (AEW) teams to operate from the fleet's carriers. They were the first squadrons set up specifically for the mission. TBM-3E/3W aircraft equipped both VAW-1 and VAW-2 upon their formation. Their careers were short-lived, as the mission was assumed by VC squadrons in September 1948. Not until 1956 did the VAW designation return.

Research and development units

During its post-war career, the Avenger also operated in support of the Navy's research and development projects, in the fleet with assignment to Air Development Squadrons (VX) or at the service's test centres. Versions of the aircraft fulfilling a multitude of roles included TBM-3E, TBM-3S and TBM-3Q Avengers, with some TBM-3Us assigned for utility work.

VX-1, VX-2, VX-3, ZX-11 (Airship Development Squadron 11); NATC Patuxent River, Maryland (Armament Test Division, Electronic Test Division, Flight Test Division, and Service Test, Division); NAOTS Chincoteague, Virginia; Aviation Ordnance, Dahlgren, Virginia; Torpedo Unit, NAS Quonset Point, Rhode Island

These TBM-3Es are seen in September 1950, while serving with Naval Air Reserve Training Unit at Oakland, California (tailcode 'F'). NARes aircraft carried an orange fuselage stripe over the standard overall 'midnight blue' paint scheme.

Above: By mid-1956, anti-submarine squadron VS-32 had changed its tailcode from 'SR' to 'MD'.

This TBM-3E Avenger was part of the Reserve fleet based at NAS Livermore in the late 1940s. The 'G' base code and '53' aircraft number were applied in orange, matching the Reserve fuselage band.

Another view from the late 1940s, this shows a formation of VA-18A (later VA-175) TBM-3Es over the Mediterranean in June 1947.

United States Marine Corps

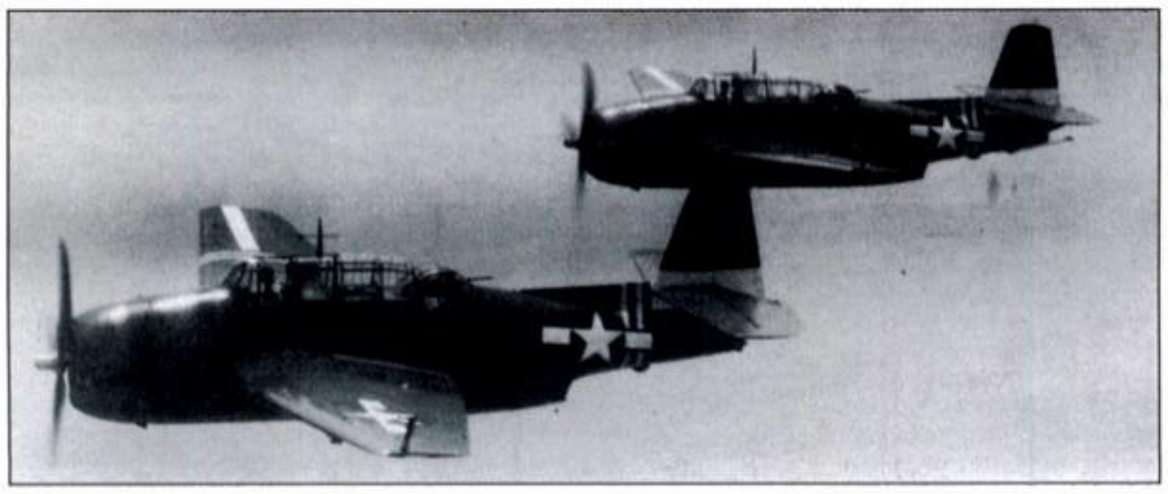
With pre-war service aboard aircraft-carriers quite limited, the experience of Marine Corps aviators in dropping torpedoes was non-existent when the United States entered World War II. The decision to establish Marine torpedo-bomber squadrons came in the midst of the Guadalcanal campaign when VMSB-131 based at Ewa, Hawaii, assumed the mission just prior to shipping out for the combat zone. According to Brigadier General George Dooley, a captain at the time, the squadron "had something like 22 days to train to learn torpedo tactics, to learn to fly a new airplane [TBF-1], and to prepare ourselves as much as possible for combat work." Assisted in this training by Navy personnel, including electricians and hydraulics people that the Marines retained in their ranks, VMSB-131 arrived at Henderson Field just in time to participate in the decisive naval Battle of Guadalcanal.

Other squadrons followed VMSB-131's lead and were equipped with Avengers. Not until June 1943, however, did the Marine Corps adopt the designation VMTB (Marine Torpedo-Bomber Squadron) for these new units. All told, 23 VMTBs filled Marine Air Wings during the course of World War II, although about half were based Stateside in the training role. Like their Navy counterparts, most began flying TBF-1s and ended the war equipped with TBM-3/3Es.

The vast majority of Marines who flew Avengers logged combat missions from airstrips captured as the island-hopping campaign made its way across the Pacific. Along with Marine fighter and scout-bomber squadrons, VMTB units helped pound Rabaul and carried out the traditional role of Marine aviation –close air support of troops on the ground. However, as the tide of Allied conquest reached farther west, targets became increasingly out of range of single-engined land-based aircraft, leaving Marine Corps aviation in the backwaters of the Pacific war. This changed in June 1944 with the agreement that Marine squadrons would be assigned to aircraft-carriers, and four months later came the establishment of Marine Carrier Groups, Aircraft, Fleet Marine Force, Pacific. VMTB squadrons were assigned to escort carriers with the primary mission of close air support, and by July 1945 they were part of nine Marine Carrier Air Groups (MCVGs).

Loaded with rockets, a VMTB-232 TBM-3 hunts for prey over Okinawa, some time in June 1945.

Below: VMTB-132 operated TBM-1s from USS* Cape Gloucester *(CVE-109) off the Saddle Islands, in late July 1945. The distinctive fuselage and tail markings were introduced to better identify aircraft from CVEs, in June 1945. The broad stripes were white; the narrower bands, yellow.

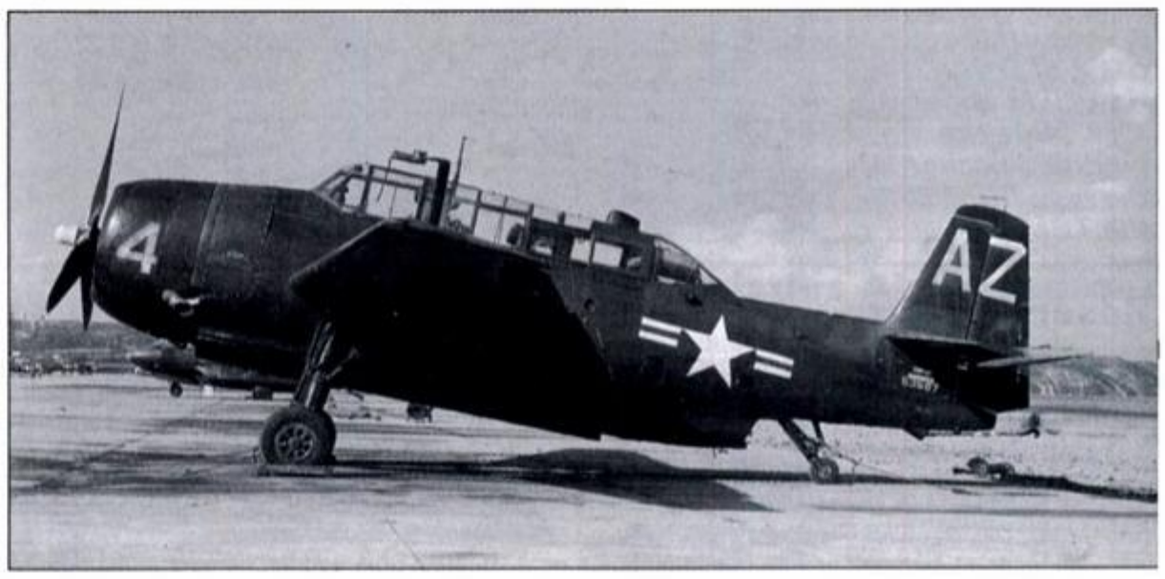


Marine Torpedo Bomber Squadrons
VMTB-131, VMTB-132, VMTB-134, VMTB-141, VMTB-143, VMTB-144, VMTB-151, VMTB-231, VMTB-232, VMTB-233, VMTB-234, VMTB-242, VMTB-332, VMTB-453, VMTB-454, VMTB-463, VMTB-464, VMTB-473, VMTB-621, VMTB-622, VMTB-623, VMTB-624, VMTB-943

Although VMTB squadrons were the primary Marine Corps operators of the Avenger, single examples appeared in the inventories of a number of other units, mainly Headquarters and Service squadrons (HEDRON and SERVRON) of the various Marine Air Groups (MAG) and Marine Air Wings (MAW). Additionally, Avengers showed up as hacks in some Marine fighter squadrons, including VMF-112, VMF-123, VMF-221 and VMF-451, as well as in the First Marine Division, where a lone torpedo-bomber was probably the personal transport for the commanding general. Following the war, some HEDRONs continued to operate TBM-3Es. However, front-line squadrons did not keep the Avenger as long as their Navy counterparts, with only VMC-2 showing the aircraft on its rolls in the early 1950s.

Below: A TBM-3 drops supplies near MCAS Ewa, Hawaii as part of its close air support training in July 1945.

This TBM-3R COD aircraft was operated by HEDRON-1 (Headquarters Squadron, Marine Air Wing One).

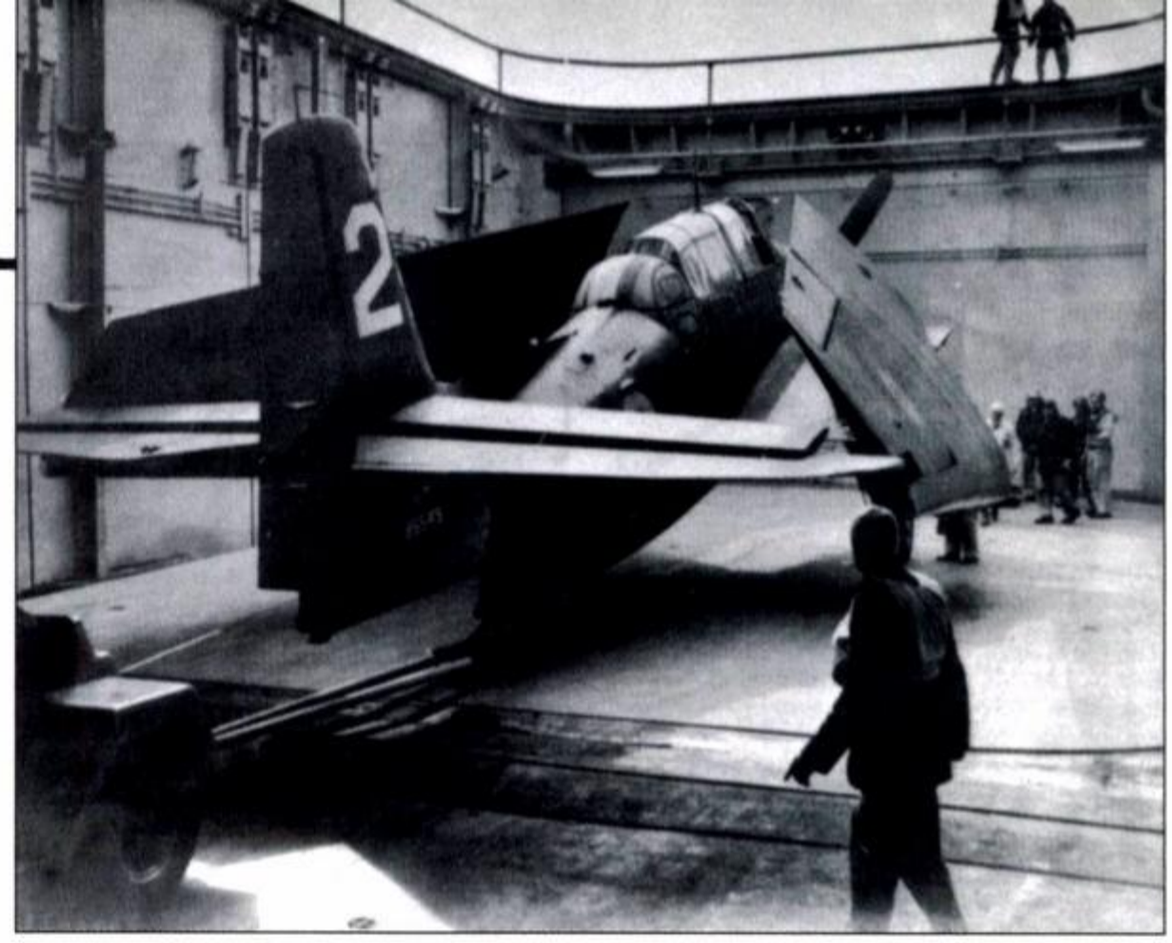


Brazil
Aviação Naval

Six ex-RN Avenger AS.Mk 4s were transferred to Brazil from Dutch stocks, two being aircraft converted to target-towing configuration. The first batch was handed over in July 1960, receiving the serials N-501 to N-503. When N-502 was written off in a ditching, N-503 was renumbered N-502. These aircraft were used for carrier qualifications in the North Sea of the Brazilian carrier *Minas Gerais* (ex-HMS *Vengeance*) which had been refitted in Rotterdam.

The second batch of Avengers was numbered N-504 to N-506. The career of the Brazilian Navy's Avengers was brief – when the responsibility for providing aircraft for the carrier transferred to the Força Aérea Brasileira in 1961, the aircraft were placed in storage at the naval barracks in Rio de Janeiro, and were no longer on strength by 1965.

Five of the six aircraft are known to be: U-25 (ex-XB445), U-26 (ex-XB447), U-28 (ex-XB385), U-32 (ex-XB378) and U-34 (ex-XB331)



***Aircraft '2' (possibly N-502) had been U-25 in the MLD, XB445 in the FAA and originally BuNo. 85549 in the USN. It is seen here aboard Brazil's sole aircraft-carrier,* Minas Gerais.**

Canada
Royal Canadian Navy

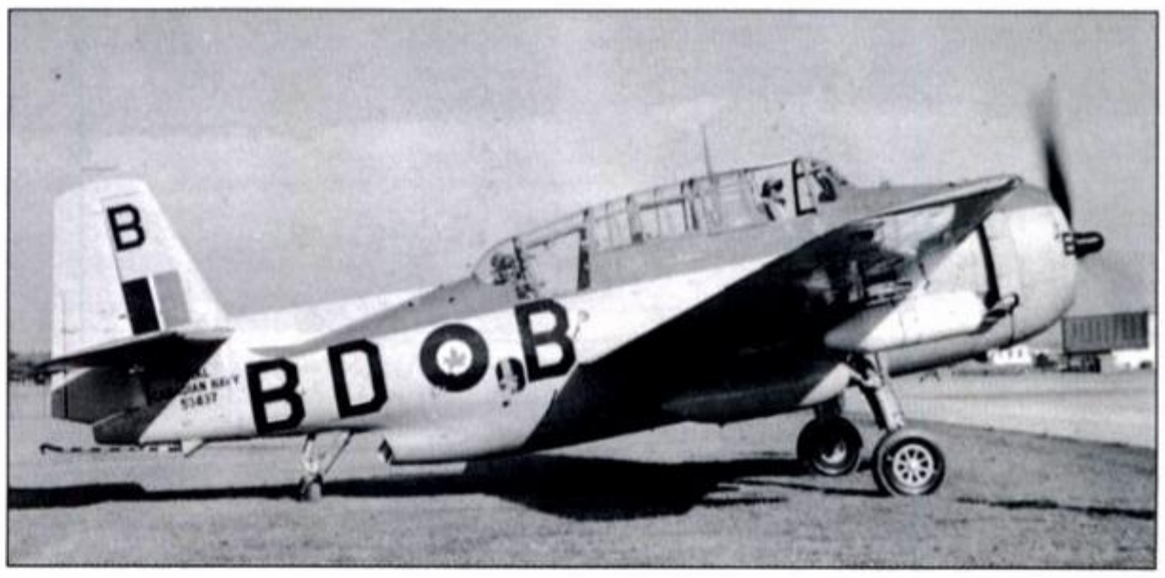
Canadian Avenger operations date from 1944 when HMS *Nabob*, a 'Ruler'-class escort carrier, was operated under Royal Navy control, but commissioned in the RCN with a mostly Canadian crew. Its complement included No. 852 Squadron with Avenger Mk Is and later a detachment of No. 856 Squadron with Mk IIs.

In all, 125 aircraft saw RCN service between 1950 and 1957. The bulk (117) were ex-USN TBM-3Es and -3Ss and arrived in May 1950. Known as Avenger AS.Mk 3s in RCN service, 16 were modified by Fairey Aviation Company of Canada Ltd to AS.Mk 3M standard with a MAD boom. A number were modified as target tugs with a raised cockpit 'greenhouse'. The balance of the Canadian Avenger fleet was acquired in September 1952, these being eight TBM-3W2s, known as Avenger AEWs in RCN service.

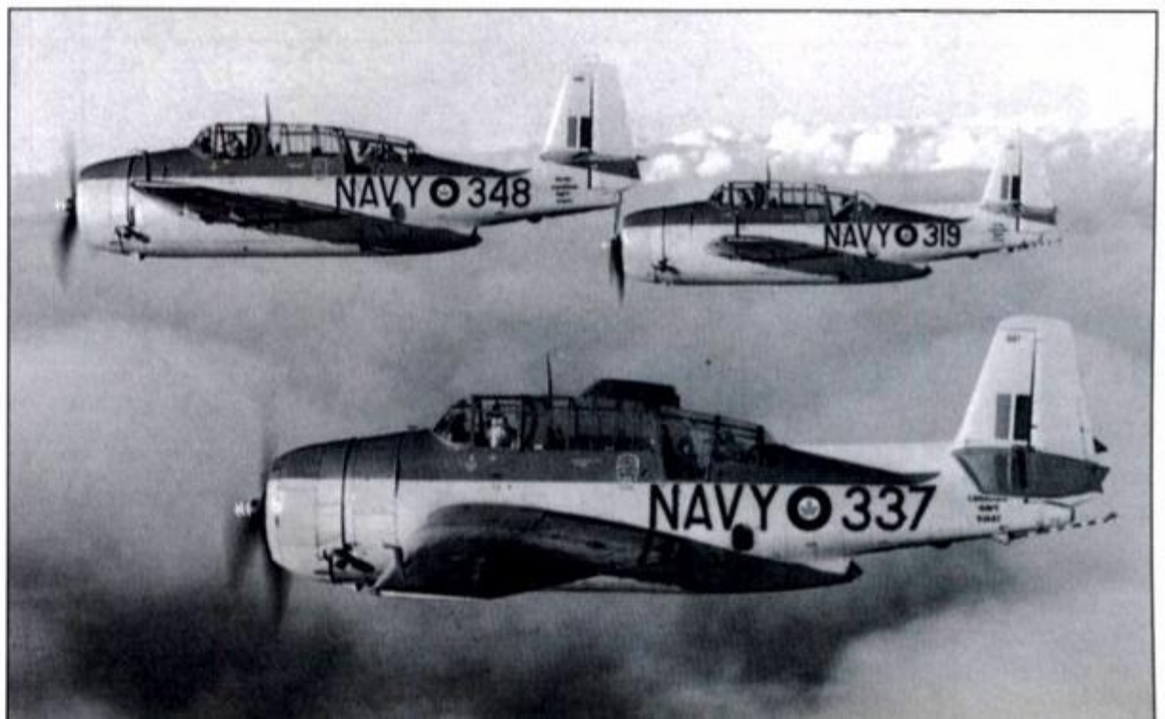
Six squadrons operated the type, including two anti-submarine units. No. 825 Squadron reformed on 1 July 1945 as a Canadian-manned unit equipped with Barracudas and formally transferred to the RCN in January 1946, upon the commissioning of HMCS *Warrior*. Later re-equipping with Fireflies, it was renumbered No. 880 Squadron at Dartmouth, Nova Scotia in May 1951, picking up seven TBM-3Es in November for service in HMCS *Magnificent*. From November 1952, the squadron was known as VS-880, the Avengers staying on until replacement with CS2F Trackers began in October 1957.

In a similar fashion to No. 825 Squadron, No. 826 reformed as an RCN unit in May 1947 with Fireflies aboard *Warrior*. Transferred to *Magnificent* in March 1949, the unit re-equipped with 12 TBM-3Es in October 1950. From May 1951, the squadron was designated No. 881, then VS-881 from November 1952. In March 1955, a flight of four TBM-3W2s was added, both variants serving until March 1957, when CS2F Trackers arrived.

Other RCN units equipped with the Avenger were VC-920 (a training unit within the Reserve Air Group), VT-40 (a flying training unit), VU-32 (a utility squadron) and VX-10 (a test unit for new aircraft types). The last AS.Mk 3s and Mk 3Ms were withdrawn in July 1960, the 'AEWs' having been pensioned off in March 1959.



Clockwise from above: VS-881's TBM-3Ss (Avenger AS.Mk 3s) served aboard HMCS* Magnificent *during 1952, adopting the codes 'AB-x'. This aircraft (BuNo. 86233) features the later standard 'stinger' arrester hook, AN/APS-4 radar and zero-length rocket rails; VS-880's aircraft carried 'BD-x' codes; later 300-series number codes replaced the letter code system used by VS-880; a number of the RCN's Avengers were TBM-3Es, like these No. 826 Squadron examples. The 'VG' code under the wing was part of the aircraft's full callsign, 'VG-ABA'.

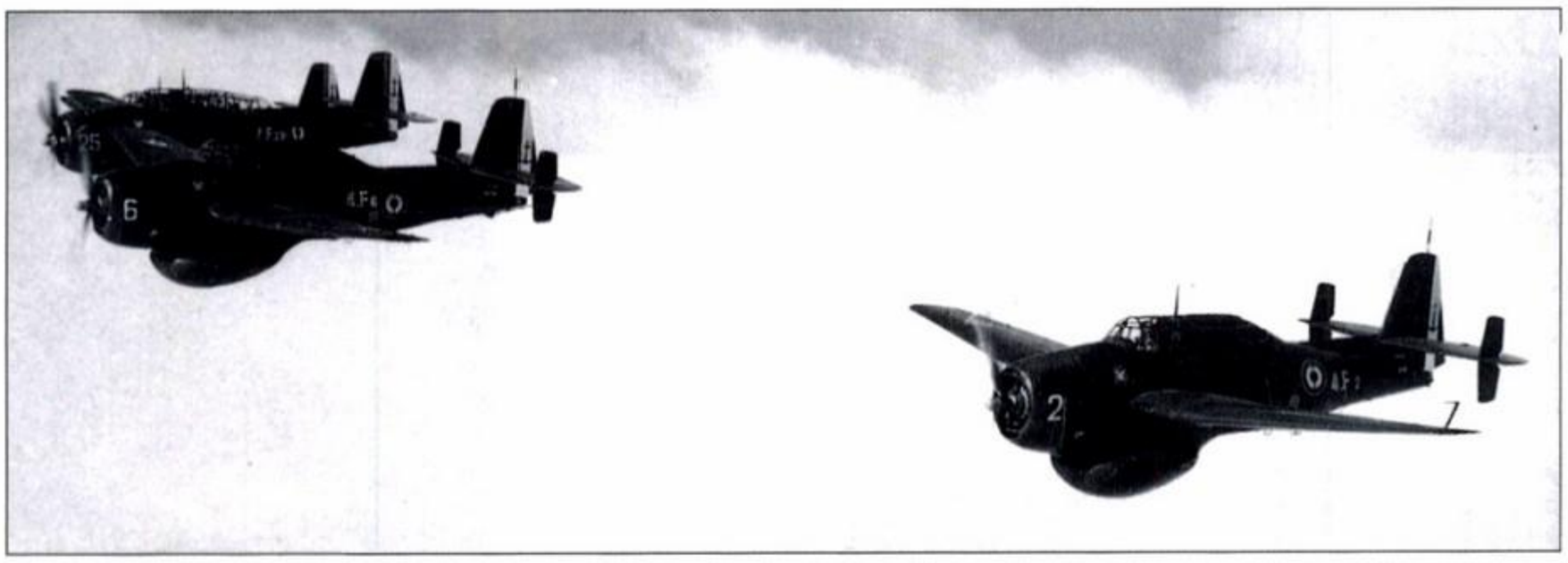


France

Aéronautique Navale

Under the MDAP, 140 Avengers (TBM-3Es, -3S and -3S2s, -3Us and -3W2s) were delivered to the Aéronavale, between May 1951 and April 1958. A small number of ex-FAA AS.Mk 4s were also transferred from the UK in 1957. Fitted with French equipment, some aircraft carried the unofficial designations TBM-53 (TBM-3E), TBM-57 (TBM-3S/-3S2) and TBM-UT (TBM-3U). From September 1951, 4 Flottille introduced the first French Avenger 'hunter/killer' teams (TBM-3S and -3W2 aircraft), operating the type until February 1960. 6 Flottille and 9 Flottille were similarly equipped, the former until November 1959 and the latter until September 1960. All operated from shore bases and from the carriers *Arromanches*, *Bois Belleau* and *Lafayette*. 4F and 9F participated in the Suez operation of October/November 1956, the former also operating the type in Tunisia until 1958.

In the training and support roles, 2, 3, 4, 5, 10, 15, 54 and 56 Escadrilles de Servitudes operated Avengers, the last of which were retired in April 1966.



Above: 4F TBM-3W2s had a sub-hunting role in the Aéronautique Navale and were finished in overall 'midnight blue', with prominent* tricolore *rudder striping.

Below right: 9F operated its aircraft from* Arromanches *and shore bases during the Suez campaign.

Below: The badge on the nose of this TBM-3S belongs to 10S, one of nine non-operational TBM units.

Japan

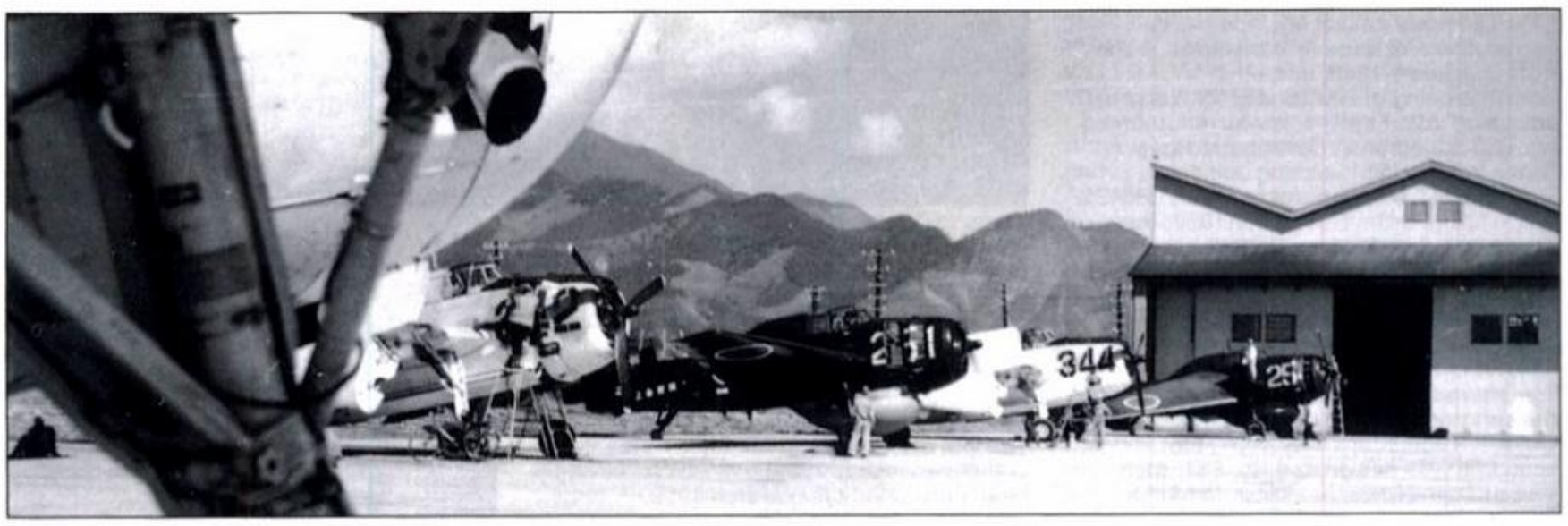
Nihon Kaijyo Jietai/Japanese Maritime Self-Defence Force

Among the first aircraft of the JMSDF, formed in 1950 as the Maritime Guard and renamed on 1 July 1954, were 10 TBM-3W2s (serialled 2101-2110, later 2251-2260). Delivered in November, they were ferried to Kanoya AB for the Kanoya Koku-tai Dai 2 Hiko-tai (Kanoya Air Wing, 2nd Squadron).

Twelve months later, the first of 10 TBM-3S2s (serialled 2341-2350) arrived and were issued to Kanoya Koku-tai Dai 3 Hiko-tai (Kanoya Air Wing, 3rd Squadron). In May 1957, Dai 2 Hiko-tai was disbanded and the TBM-3W2s transferred to Dai 4 Hiko-tai, still based at Kanoya, though by mid-July both units had been disbanded. Their aircraft moved to Hachinohe AB and were assigned to Hachinohe Koku-tai Dai 11 Hiko-tai (Hachinohe Air Wing, 11th Squadron).

Operated in the ASW training role, the Avengers were not in good condition when they arrived, serviceability suffering as a result. Withdrawals began as early as 1957, and by 1960 only six remained airworthy. These aircraft were finally retired the following year, a number being returned to the US, while others were handed over to the maintenance training establishment, at Shomofusa AB, as instructional airframes.

Some sources suggest that an additional four machines (TBM-3Rs) were purchased in the late 1950s, as a source of spare parts.



Above: A quarter of Japan's Avenger force is seen undergoing routine maintenance at Kanoya AB. The JMSDF's TBM-3W2s appear to have been finished in standard USN 'midnight blue', while the -3S2s wore a lighter two-tone scheme.

Pictured shortly after delivery, with its originally allocated serial number, a JMSDF TBM-3W2 prepares for a sortie.

Below: The yellow lightning bolt tail marking appeared on both Avenger variants operated by the Kanoya Koku-tai.

Netherlands
Marine Luchtvaart Dienst

The 78-strong Dutch Avenger fleet came from the US under the MDAP, and from the UK. First to arrive were 24 ex-USN TBM-3W2s in September/October 1953, followed, between January 1954 and May 1955, by 34 TBM-3S2s. For short-range patrol, 20 additional aircraft were acquired in January 1958, these being ex-Royal Navy TBM-3E2s (12) and TBM-3Es (eight).

Ten aircraft – five of the TBM-3S2s and five of the ex-RN aircraft – were later converted to target tugs. Eight TBM-3Ss, two TBM-3W2s and one TBM-3E were written off in service, and the ASW versions were withdrawn from service between December 1959 and May 1961.

The last of the ex-RN TBMs were finally withdrawn in October, although five (some sources say six) were transferred to the Brazilian navy, the first in July 1960.

1 Squadron (later VSQ-1) at Valkenburg replaced its Fireflies with Avengers in 1957. The squadron also operated the tug aircraft.

With 4 Squadron, 2 Squadron (VSQ-2) was an operational ASW unit based at Valkenburg, which converted to Avengers in the summer of 1954, operating from HrMs *Karel Doorman*. In late 1955, the squadron operated from HMS *Bulwark* while the *Doorman* was undergoing refit, transferring in 1959 to the Antilles, where it disbanded.

4 Squadron (VSQ-4) also received Avengers in 1954, replacing its Fireflies. This unit also spent time aboard HMS *Bulwark* and HrMs *Karel Doorman* and re-equipped with Trackers in 1960.

Above: TBM-3S2 1-27 prepares to be catapulted from HrMs* Karel Doorman, *sometime in 1959. The 34 TBM-3S2s were serialled 1-1 to 1-34; the 24 TBM-3W2s, 16-101 to 16-124; and the ex-FAA machines, 21-20 to 21-39. All surviving aircraft were later renumbered in one series, from 020 to 075.

The lack of a dorsal turret identifies this as a TBM-3S2. 1-8 (ex-BuNo. 53854) entered service in 1954 but was withdrawn and scrapped in 1959.

New Zealand
Royal New Zealand Air Force

New Zealand was the only country other than the US and UK to fly Avengers in combat during World War II. The first of 48 aircraft, all new TBF-1s (serialled NZ2501-06) and TBF-1Cs (NZ2507-48) off the production line, arrived in September 1943. They were issued to No. 30 Squadron at Gisborne, which moved to Espiritu Santo (in the Solomon Islands) in January/February 1944 before moving on to Piva on Bougainville. The aircraft were used for bombing and for spraying diesel on Japanese crops on the islands.

No. 31 Squadron followed the same route to combat in December 1943, taking over No. 30's aircraft. In October, 16 aircraft were handed to the USN at Espiritu Santo. The remainder returned to New Zealand where a number were converted to drogue-towing configuration. Nine were passed on to the British Pacific Fleet in September 1945. Six of the 12 survivors were scrapped in 1948, the rest serving as target tugs with Nos 41 and 42 Squadrons, and in aerial top-dressing (crop-dusting) trials in 1948-49. The last two were retired at Ohakea in May 1959.

NZ2505, seen shortly after assembly, was one of the six TBF-1s delivered to the RNZAF in 1943. The inferior performance of these first machines meant they were confined to New Zealand and used for conversion training.

TBF-1C NZ2547 is seen on Espiritu Santo being repaired, en route to Bougainville. The aircraft had left New Zealand with two others to join No. 30 Servicing Unit in the Solomon Islands, but had been damaged at Santo. Eventually flown to Bougainville, it served with No. 31 Sqn.

Right: No. 42 Sqn target tugs formate for the RNZAF photographer in 1955. The tugs' fuselages were natural metal with high-visibility black and yellow stripes on the lower surfaces of the fuselage and wings.

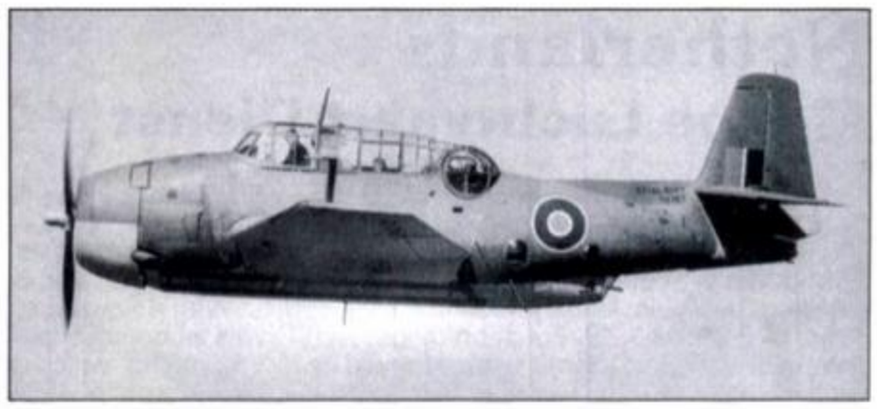
United Kingdom
Fleet Air Arm

Next to the US Navy and Marine Corps, the Royal Navy's Fleet Air Arm operated the largest number of Avengers during World War II, taking delivery of 958 examples under the terms of the Lend-Lease agreement. The first aircraft arrived in 1943 and were initially known as Tarpons, after a species of fish (the naming policy of the period specifying names of marine animals and fishes for torpedo spotter reconnaissance types), though the type was renamed Avenger on 13 January 1944 as part of an effort to standardise the names applied by the Allies to the same aircraft design. The first Avengers to serve with an FAA unit were those TBF-1s loaned to No. 832 Squadron (see below). Twelve were embarked in HMS *Victorious* as it sailed for the Pacific, but 25 TBFs have been identified as having served with No. 832, including those flown during work-up.

Most FAA Avenger units operating in the Pacific formed up in the US, equipping with Avengers straight off the production line. Some were modified by Blackburn Aircraft Limited at Roosevelt Field, New York. Those aircraft destined for Atlantic and Arctic service were shipped to the UK where they were modified by Blackburn at Brough before being issued to squadrons. These modifications included fitting gun sights, an oxygen system and radio gear of standard British type, removing the ventral gun and fitting an F.24 camera in its place, relocating the navigator's station closer to the pilot and fitting a folding radio mast so that the aircraft could be stowed in the cramped hangars aboard British carriers.

FAA Avenger orders and deliveries under Lend-Lease were as follows:

With part of its serial number crudely sprayed on its nose, Avenger Mk I JZ159 is seen, probably in early 1944, carrying the markings of No. 852 Sqn. Formed at Squantum, Mass. in November 1943, No. 852 served aboard the Canadian carrier HMS* Nabob *during 1944.



***Above: These No. 848 Sqn aircraft were photographed on a bombing raid in 1945. The 'X' tailcode indicates the unit's carrier base, HMS* Formidable.**

Left: Invasion stripes on this No. 850 Sqn Avenger indicate involvement in Operation Overlord. With Nos 854 and 855 Sqns, the unit came under the control of RAF Coastal Command, carrying out anti-shipping patrols in the English Channel.

Above right: One of the first Avengers delivered to the FAA, FN767 was the first of a number of TBMs seconded to the A&AEE, arriving at Boscombe Down on 5 April 1943 for handling trials.

Tarpon/Avenger TR.Mk.I: 402 delivered
FN750/FN895 (TBF-1B), FN896/FN949, JT773, JZ100/JZ300 (TBF-1B or -1C)

Avenger TR.Mk II: 334 delivered
JZ301/JZ360 (TBM-1), JZ361/JZ634 (TBM-1C)

Avenger TB.Mk III: 219 delivered
JZ635/JZ650 (TBM-3), JZ651/JZ720 (TBM-3E), [JZ721/JZ746 (TBM-3E) apparently not delivered], KE430/KE479 (TBM-3E) of which KE434, 438, 440, 444, 448-453, 457-459, 462, 464, 468-479 not delivered, KE480/KE539 (TBM-3E) not delivered

Avenger Mk IV: 70 cancelled
(KE540/KE609) (TBM-3S or -4)

As well as the Lend-Lease aircraft, 76 reconditioned ex-USN aircraft were allocated serial numbers in August 1945, having been delivered in July, mostly to Lockheed's AAU facility at Renfrew; most were stored upon arrival in the UK. These were a mixture of TBF-1C, TBM-1, -1C and -3 aircraft and were serialled VL401/VL410, VL432/VL461, VL475/VL494, VL501/VL510, VL994/VL999. At least three of these aircraft were ex-RNZAF machines.

In addition to the aircraft operated between 1943 and 1946, a batch of 100 TBM-3s was supplied in 1953 under the Mutual Defense Assistance Program, to bolster the RN's ASW capability in the face of delays suffered by the Fairey Gannet. As well as replacing Fairey Fireflies, the Avengers also filled a strike role, replacing Barracudas. After two years in front-line service, the aircraft joined RNVR squadrons, serving until 1957. A few development airframes were retained until 1962. The MDAP Avengers were:

Avenger AS.Mk 4/5/6: 100 delivered
XB296/XB332, XB355/XB404, XB437/XB449 (TBM-3E/-3E2/-3S)

The first MDAP aircraft were actually standard USN aircraft and were thus referred to by the FAA as TBM-3Es. Later, Avenger AS.Mk 4s (TBM-3Es fitted with British equipment) entered service, followed by AS.Mk 5s (TBM-3E2s fitted with British equipment, including radar in a radome under the starboard wing) and AS.Mk 6s (TBM-3Ss fitted with British equipment, including a radome beneath the forward section of the bomb bay).

Wartime Avenger units

No. 820 Squadron
Equipped with Fairey Albacores, this squadron had been involved in support of the landings in North Africa at the end of 1942, those in Italy the following year and (with Barracudas) had taken part in unsuccessful attacks on the German battleship *Tirpitz* in mid-1944. In October 1944 it re-equipped with 21 Avenger Mk Is, but soon exchanged them for Mk IIs and embarked in HMS *Indefatigable* for the Far East in November. Joining No. 2 Strike Wing in Ceylon, the unit was involved in the attacks on oil refineries at Palembang, Sumatra from January 1945 and during March, April and May made numerous attacks on the Sakishima Gunto group of islands in the East China Sea. In June it joined the 7th CAG, bombing targets in the Tokyo area just prior to VJ-Day. No. 820 returned to the UK in early 1946, disbanding in March.

No. 832 Squadron
Formed at Lee-on-Solent in April 1941 as a torpedo spotter reconnaissance unit equipped with Albacores, No. 832 operated from HMS *Victorious* during Operation Torch in November 1942. The following month it left for the US to re-equip with Avengers, the first FAA squadron to operate the type. With 12 ex-US Navy TBF-1s aboard, *Victorious* sailed for the Pacific via Panama (after working up at Norfolk, Virginia). In June 1943 the squadron operated from USS *Saratoga* in support of landings in the Solomon Islands, the first time FAA aircraft had operated from a US carrier. By the end of July it had rejoined *Victorious*, in which it returned home, re-equipping this time with Avenger Mk Is at Hatston in September. Shore-based operations against enemy shipping followed, but in February No. 832 embarked again in *Athene* and *Engadine* for Ceylon, as part of the East Indies Fleet. Operations from *Illustrious* followed, including a bombing raid on Surabaya in May. No. 832 joined *Begum* later that month for trade protection duties in the Indian Ocean. With Avengers from No. 851 Squadron and assistance from HMS *Findhorn* and RINDN *Godavari*, No. 832 Avengers sunk *U-198* on 12 August. In the New Year, the ship sailed for the UK, the squadron disbanding on arrival.

No. 846 Squadron
The first FAA unit to operate Avengers in home waters, No. 846 was formed at Quonset Point in April 1943. A torpedo reconnaissance bomber unit with 12 Avenger Mk Is, the squadron joined HMS *Ravager* in July and returned to the UK, carrying out anti-submarine patrols en route. After working up in Scotland, No. 846 began anti-submarine patrols for the Gibraltar convoys in January 1944 aboard HMS *Tracker*. In late March the squadron escorted a convoy to Russia, sighting and attacking six U-boats en route, sharing the sinking of *U-355* with HMS *Beagle* north of the Arctic Circle on 1 April. On 4 April an Avenger, with a Wildcat Mk V from the squadron's Fighter Flight and a Swordfish from No. 819 Squadron aboard HMS *Activity*, destroyed U-288.

No. 851 Squadron
Formed at Squantum, Massachusetts in October 1943 as a torpedo-bomber reconnaissance unit equipped with a dozen Avenger Mk Is, No. 851 embarked in HMS *Shah* the following January for service in the Indian Ocean. The unit gained a fighter flight of Wildcats in April, and in August saw action at last, attacking three U-boats. After a refit at Durban, South Africa the following February, *Shah* returned north, No. 851 attacking coastal and shore targets in Burma in April and May. During May the squadron was temporarily aboard HMS *Emperor* and from this ship attacked a Japanese cruiser and destroyer on 15 May. Returning to the UK after the Japanese surrender, No. 851 disbanded in October 1945.

No. 853 Squadron
Another Avenger unit formed at Squantum, No. 853 was formed on 1 December 1943 as a torpedo-bomber reconnaissance squadron with 12 Avenger Mk IIs. The following May it sailed for the UK in *Arbiter*. In September the unit (by now with a fighter flight of Grumman Wildcats) joined *Tracker* and in October the squadron was carrying out anti-submarine patrols while escorting a Russian convoy. Two U-boats were sighted. January 1945 brought a change to HMS *Queen* and roles of anti-shipping and anti-submarine strikes, plus mine-laying sorties, off the Norwegian coast. More Russian convoy escorts occupied the unit until VE-Day, No. 853 disbanding at the end of May.

No. 854 Squadron
Formed on the first day of 1944, at Squantum, No. 854 left for the UK aboard HMS *Indomitable* in April. From May it undertook anti-shipping patrols in the English Channel from RAF Hawkinge, as part of No. 157 Wing, RAF Coastal Command. By September the unit had left for the Far East, without its aircraft, aboard *Activity*, working up with Avenger Mk Is in Ceylon in October. Joining *Illustrious* in December, No. 854 took part in Sumatran operations and during the following March and April made attacks on the Sakashima Gunto group in the East China Sea. Re-equipment with Avenger Mk IIIs came in July, when the squadron joined the 3rd CAG. Disbandment came in December.

These six units are representative of the 15 front-line FAA units to operate the Avenger during World War II. The other squadrons in the East Indies and British Pacific Fleets operating the type were Nos 828, 845, 848, 849, 857 and a Flight of No. 885. Nos 850, 852, 855 and 856 Squadrons used it in the Atlantic, Arctic and home waters.

MDAP Avenger units

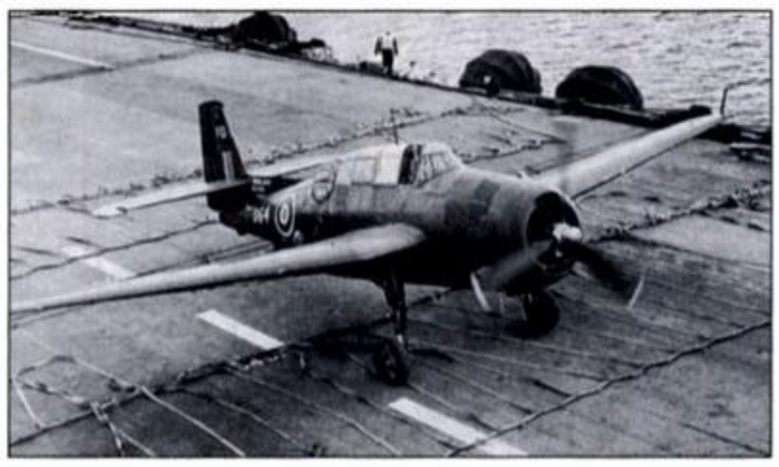
No. 815 Squadron
No. 815 reformed in December 1947 at Eglinton as an anti-submarine unit (by the renumbering of No. 744 Squadron) equipped with Barracuda Mk IIIs. Operating as the Naval Joint Anti-Submarine Squadron in co-operation with the Joint Anti-Submarine School at Londonderry, the unit was largely shore-based, though it occasionally embarked aboard carriers for exercises. The first shipment of TBM-3Es for the RN arrived at Glasgow aboard HMS *Perseus* on 30 March 1953. In May, eight entered service with No. 815, replacing the Barracudas. January 1954 brought re-equipment with Avenger AS.Mk 4s and a cruise aboard HMS *Eagle* (in the Mediterranean), followed in July by another change to AS.Mk 5s and, later, a cruise aboard *Illustrious* (in home waters). No. 815 returned to the Mediterranean the following July, in *Albion*, but upon its return to the UK in October the unit disbanded.

The other MDAP Avenger units were No. 824 Squadron (TBM-3Es/AS.Mk 4s, July 1953 to February 1955), No. 820 Squadron (AS.Mk 4s, February 1954 to March 1955) and No. 814 Squadron (AS.Mk 4s/5s, March 1954 to November 1955). In addition, No. 751 Squadron, the one-time Radio Warfare Unit, was elevated to front-line status, as No. 831 Squadron.

Midnight-blue TBM-3E/Avenger Mk 4 XB444 '065/FD' was among the MDAP aircraft delivered from 1953. Note the No. 703 Sqn (Service Trials Unit) badge on the engine cowling.

Another No. 703 Sqn machine, this Avenger Mk III is seen aboard HMS* Eagle *during trials in January 1953. Note the pre-1947 Type 'B' national insignia, later replaced by Type 'C', as on XB444.

***No. 815 Sqn was one of the four front-line ASW units equipped with MDAP Avengers during the 1950s. AS.Mk 4 XB396 362/'J' is seen here with other No. 815 aircraft on the deck of HMS* Eagle.**



No. 831 Squadron
Restyled as the Electronic Warfare Unit in March 1958, No. 751 Squadron achieved front-line status in May and was accordingly renumbered No. 831 Squadron. Its initial equipment consisted of four Avenger AS.Mk 6s and four Sea Venom Mk 21ECMs in 'A' and 'B' Flights, respectively, these aircraft participating in exercises and occasional carrier deployments. Avengers were replaced in this role by Gannet ECM.Mk 6s in June 1959, but a few appear to have been retained for a development tasking until 1962. Some sources describe these aircraft as 'Avenger ECM.Mk 6Bs'.

RNVR units

Three RNVR units operated Avenger AS.Mk 5s just prior to disbandment after defence funding cuts in 1957: No. 1830 Squadron at Abbotsinch (from November 1955), No. 1841 Squadron at Stretton (from December 1955) and No. 1844 Squadron at Bramcote (from March 1956).

Second-line units

Various training and ancillary units operated Avengers during both periods of FAA TBM operation. During the 1940s these were: Nos 700 (a Maintenance Test Pilot and Training Squadron), 702 (an Instrument Flying Training and Checking Unit), 703 (the Naval Flight of the RAF's Air-Sea Warfare Development Unit), 706 (Crew Pool and Refresher Flying School), 707 (Radar Trials Unit/Naval School of Airborne Radar), 711 (a Torpedo Training Squadron), 721 (a Fleet Requirements Unit), 733 (a Fleet Requirements Unit), 736 (the School of Air Combat), 738 (a Pilot Training Squadron), 756 (a Training Squadron), 759 (a Naval Air Firing Unit), 763 (an Anti-Submarine Operational Training Squadron), 764 (the User Trials Unit), 768 (Deck Landing Training unit), 774 (an Armament Training Squadron), 778 (a Service Trials Unit and Carrier Trials Unit), 782 (a Communications Squadron), 783 (an ASV Radar Training Squadron), 785 (No. 1 Naval OTU), 787 (the Naval Air Fighting Development Unit), 797 (a Fleet Requirements Unit), 798 (an Advanced Conversion Course unit).

During the 1950s, MDAP aircraft served with: Nos 700 (the Trials and Requirements Unit formed from Nos 771 and 703 Squadrons), 703 (the Service Trials Unit/OTU), 767 (a Landing Signal Officers Training Squadron) and the following units engaged in electronic warfare tasks:

No. 744 Squadron
From March 1954, this squadron was the Naval Air-Sea Warfare Development Unit, working in conjunction with the RAF's ASWDU at St Mawgan and equipped with Fireflies and Gannets. Avenger AS.Mk 5s arrived in July 1955, some of these machines joining an 'X' Flight for radar jamming trials, this becoming No. 745 Squadron in April 1956. Meanwhile, the remainder of No. 744 was concentrating on ASW as the Naval Anti-Submarine Development Squadron, but without Avengers from the following February.

The harp marking on the nose of this TBM-3E/Avenger Mk 4 identifies it as a No. 815 Sqn machine. No. 815 was one of the four anti-submarine units equipped with MDAP Avengers as a stop-gap replacement for the FAA's Fairey Firefly Mk 6s, while the Gannet suffered development delays. All were delivered in standard USN overall 'midnight blue' finish.

No. 745 Squadron
A Radar Jamming Trials unit, No. 745 was formed at Eglinton in April 1956 from 'X' Flight, No. 744 Squadron. The four Avenger Mk 5s with which it was equipped were modified to TS.Mk 5 standard for the tactical evaluation of Orange Harvest ESM gear. Trials during 1957 included operations from HMS *Bulwark* and *Albion*, but the unit disbanded in November.

No. 751 Squadron
Upon its third reformation in December 1951, No. 751 was based at Watton as a Radio Warfare Unit. Created from the RN component at the Central Signals Establishment, the squadron undertook trials of ECM equipment and assisted with fleet training with a mixed collection of aircraft (including Avenger AS.Mk 4s from December 1952), although by June 1957 the unit was equipped exclusively with Sea Venom Mk 21ECM aircraft ('A' Flight) and Avenger Mk 4s ('B' Flight). During this period aircraft were frequently detached to take part in exercises, including occasional embarkation in carriers. The unit was redesignated as No. 831 Squadron.

Royal Air Force

No. 567 Squadron
An anti-aircraft and army co-operation squadron formed at Detling on 1 December 1943 from No. 1624 Flight, No. 567 operated a variety of aircraft, including Martinets, Hurricanes and Oxfords. The unit's equipment was not confined to air force types; Fairey Barracudas were also employed. Another naval aircraft believed to have served with No. 567 was the Avenger, at least one Mk III serving with the unit, which disbanded in June 1946.

A&AEE

Eleven Avenger Mk Is and IIs were allotted between 1943 and 1945 to Aeroplane & Armament Experimental Establishment, Boscombe Down for various trials, including handling, armament (including rocket projectiles) and navigation trials. A notable aircraft was Mk I FN895, modified with a Fraser-Nash FN.95 remotely-controlled, twin-barrelled turret with 0.5-in (12.7-mm) guns (of the type intended for the Fairey Spearfish) in place of the standard Grumman turret.

Commissioned in 1953, HMS Centaur is seen here in the Mediterranean in 1954, having just received its first aircraft, including Avenger AS.Mk 4s from No. 820 Sqn.

Known as an Avenger ECM.Mk 6B, XB446 was among the aircraft equipping No. 831 Sqn, the Electronic Warfare Unit, in the late 1950s. Note the retractable radome under the centre-section, a distinguishing feature of the Avenger Mk 6.

Uruguay

Servicio Aeronáutico de la Armada/ Aviación Naval Uruguaya

Nine TBM-1Cs (serialled A-551 to 559) were delivered to Uruguay from the US in December 1949, followed by a mix of 10 TBM-1s and TBF-1s (A-501 to 510) in May 1950. Employed mainly for coastal patrol duties from Laguna del Sauce, they were replaced by Martin Mariners in 1956/57.

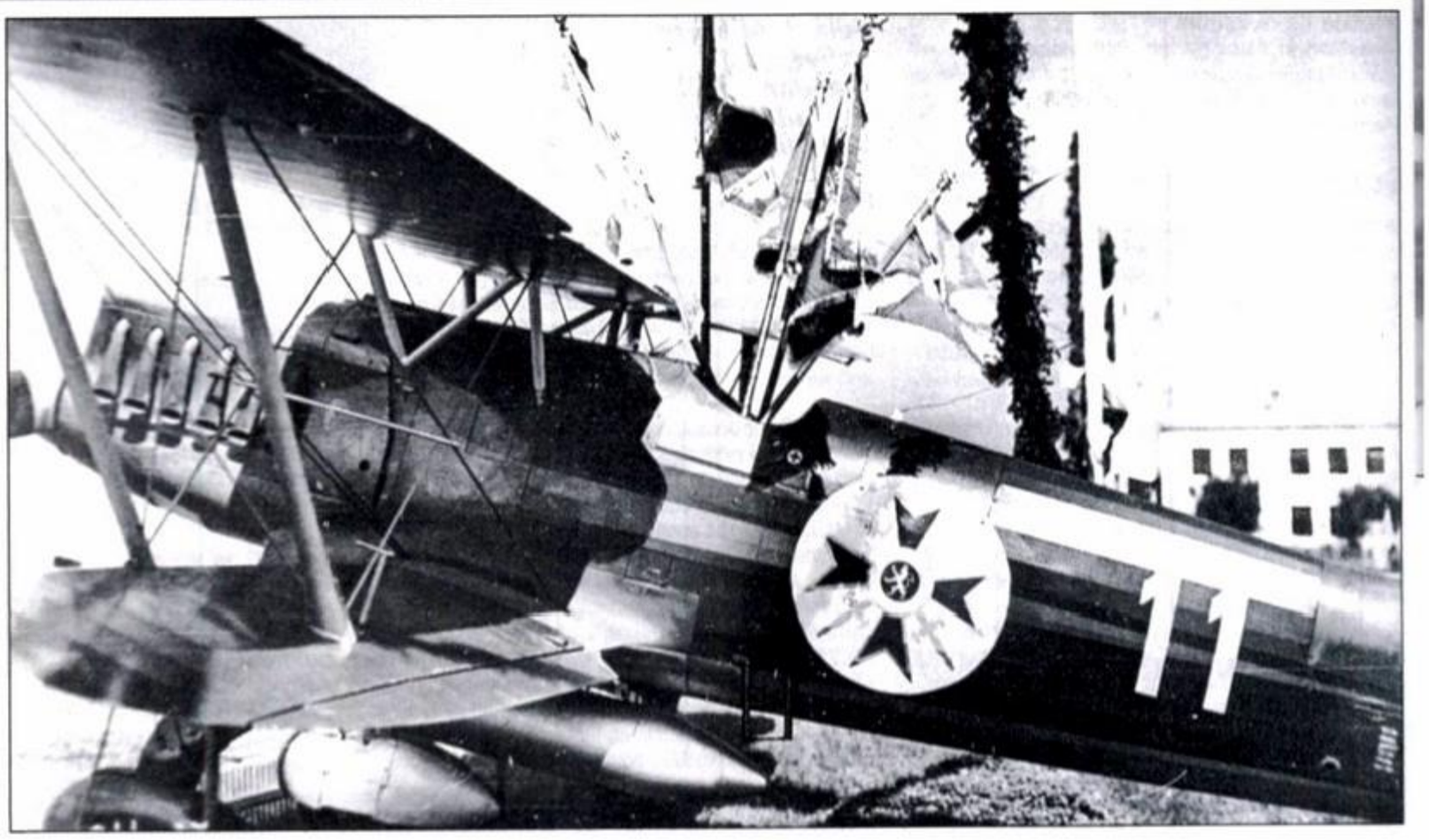
A number were distributed to the Escuela de Especialización Aeronaval (Naval Air Conversion School), also at Laguna del Sauce, as early as 1952, and more were sent to the school when the Mariners arrived. The survivors were reportedly grounded in 1960.

Perhaps the least known of the Avenger operators, Uruguay's navy operated early production aircraft like this TBM-1C.

A Decade of Air Power

Bulgaria 1940-1949

Equipped with aircraft of varied age and provenance in 1940 when war reached the Balkans, Bulgaria's air force fought first for and then against the Axis. By late 1944, it was supporting its former enemy, the Soviet Union, and post-war became one of the best armed of the 'client states'.



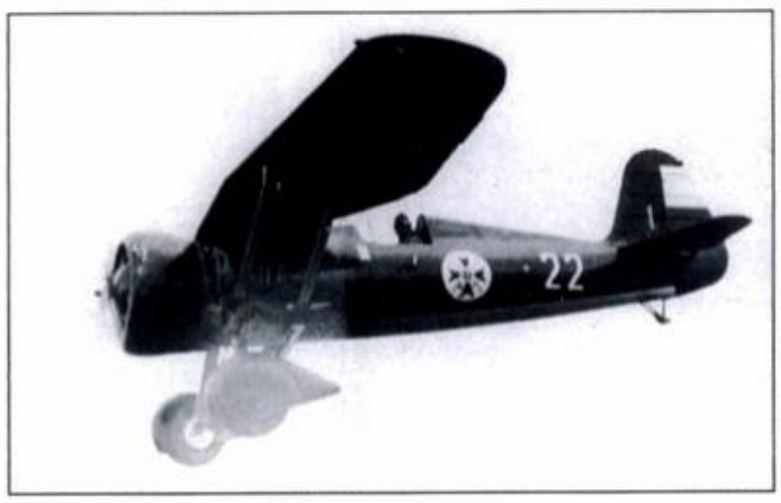
Above: On 27 June 1937, Tsar Boris III presented each of the newly-formed orlyaks (wings) with their standards, here displayed in an He 51, at Bojourishte airfield.

Top: The main player in the air defence of the Bulgarian capital was 3/6 Orlyak. In March 1943 it received its first 23 Bf 109G-2s, supplemented by a number of G-6s in early 1944. The 'Gustav' was the most capable VNVV fighter of the war.

Like many European air arms, the history of the Bulgarian Air Force during the 1940s was eventful and dramatic. A small country, located in the heart of the Balkans, Bulgaria entered into the fourth decade of the century as a still-neutral but in fact strongly pro-German state. It eventually joined the Axis on 1 March 1941, declaring war on both Britain and the US six months later. The moderate and poorly-equipped air arm of the late 1930s steadily matured during the wartime years into a small but capable force, able to mount fierce resistance to the Allied bomber raids against Sofia in late 1943 and early 1944. Following the 9 September 1944 pro-Allied coup, the air arm was immediately put into operation against the armed forces of yesterday's partner – Nazi Germany.

After the end of the war, Bulgaria fell into total dependency on the Soviet Union as a direct result of the 1944 Yalta agreement of 'spheres of influence' division of Europe. The air force was radically reformed in the Soviet style and rapidly re-equipped with huge numbers of front-line aircraft, supplied by the new 'brother in arms'. By the eve of the Cold War, it had emerged as one of the most capable and fastest-growing air arms in the region.

Vazhdushnite na Negovo Velichestvo Voyski (His Majesty's Air Force) entered the 1940s rapidly establishing a modern front-line structure, predominantly with German assistance. 1940 was the last of the pre-war years for the small Balkan kingdom. Having been a strong German ally during World War I, Bulgaria was a natural candidate to join the Axis: first, so that it could prevent a potential Reich occupation when the Wehrmacht launched the Yugoslavian and Greek invasions; and second, to regain the territories lost after the end of World War I.



The PZL P.24B gull-winged fighter, 12 of which were procured in 1937, remained in use with one front-line yato (squadron) until 1941. This aircraft wears the pre-war national insignia, the Bravery Crest, adopted in June 1937.

Secret origins

The 1919 Paris Peace Treaty called for almost complete demolition of the Bulgarian armed forces. The country was prohibited from establishing any military aviation structure for 20 years. Almost the entire air force inventory – a total of 70 aircraft, 100 aero engines and 76 machine-guns – was destroyed under the strict control of the Allied occupation corps. The country was restricted to buying civil aircraft from the Allies as the power rating of their engines was restricted to 180 hp (135 kW). Several World War I-era airframes and engines, however, were hidden and later clandestinely used for training. In the late 1920s and early 1930s a number of light aircraft were bought or built by local factories. In order to provide its 'hidden' air force with cheap but modern trainers, reconnaissance and light attack aircraft, in 1925 the Bulgarian government established at Bojourishte near Sofia an indigenous aircraft factory – DAR. In 1931 Caproni established its own factory in Kasanlak named Bulgarski Caproni. It rapidly started licensed production of trainers for local use and in the late 1930s produced several indigenous designs.

In the mid-1930s, when it became absolutely clear that Europe was on the edge of a new large-scale war, both Tsar (King) Boris III and the Bulgarian government took active steps towards the creation of a capable air force. The formal rebirth of the Bulgarian air force took place on 27 June 1937 at Bojourishte airfield. Tsar Boris III handed over the standards of the four newly-formed orlyaks (wings) as he donated 12 Dornier Do 11 bombers and 12 Arado Ar 65 fighters, paid for from his own pocket. The other aircraft of the emerging air arm were 12 He 51 fighters and 12 He 45 reconnaissance aircraft, delivered in late 1936. Twelve Polish-

The VNVV's first fighter type was the Heinkel He 51B, 12 second-hand examples of which were delivered to the still 'hidden' air arm in late 1936. In the early 1940s the survivors, proudly wearing the new insignia of the air arm, were used as advanced trainers with the Fighter School at Stara Zagora.

made PZL P.43B reconnaissance and close support aircraft (an export version of the PZL P.23) and 12 PZL P.24 fighters were taken on strength in 1938 and 1937, respectively. Thirty-six P.23Bs were delivered in 1939 and two more in 1941. Soon after the German occupation of Poland, the serviceability of the Polish-made aircraft fell to an extremely low level due to lack of vital spare parts.

The 1938 Thessaloniki Treaty between Bulgaria, Britain and France finally abolished the Paris Treaty limitations on Bulgaria's military aviation. Soon after the beginning of the war, Bulgaria turned toward the Third Reich as the sole supplier of defence equipment. By that time, however, the Reich's aviation industry was busy supplying the Luftwaffe with state-of-the-art front-line aircraft. The RLM (Reich Air Ministry) was able to offer to the VNVV mainly newly-built trainers and reconnaissance aircraft, and only a small number of modern fighters and bombers. These were insufficient for establishing a strong air arm of the kind Tsar Boris III envisaged.

Czechs accepted

The solution to the problem was procurement of the remains of the air force of Czechoslovakia, known after 5 March 1938 as the Reich's Bohemia and Moravia Protectorate. A total of 214 aircraft of the former Czechoslovak air force was delivered, comprising 62 second-hand Letov-Smolik S 328 reconnaissance aircraft, 32 Avia B 71s (a licensed Tupolev SB) and 12 Aero MB 200s (licensed Marcel Bloch MB 200En-4) medium bombers, as well as 29 Avia B 122 trainers and one Aero B 304 photo ship. In the summer of 1939 the VNVV ordered 78 brand-new Avia B 534 biplane fighters, and a year later another agreement was signed for the local assembly of 12 Avia B 135 fighters, followed by large-scale licensed production. Between 1936 and 1941 the RLM itself supplied a total of 203 aircraft – 19 Messerschmitt Bf 109E-4, 12 Heinkel He 51, 12 Arado Ar 65 and six Focke-Wulf Fw 56 fighters, 18 Dornier Do 17 and 12 Do 11 bombers, eight Fw 58 and 12 He 45 reconnaissance aircraft, two Junkers Ju 52/3m transports, six Bf 108 and three Fieseler Fi 156 liaison aircraft, and six He 72, 40 Fw 44, 12 Bücker Bü 181 and 24 Ar 96 trainers. The indigenous aircraft industry provided the VNVV with a large number of various trainers, reconnaissance and light attack aircraft. Between 1936 and 1941, 154 were delivered – 24 DAR-3 (Series I, II and III) and 46 KB-5 reconnaissance aircraft, 28 KB-4 trainer/reconnaissance aircraft, 10 KB-309 twin-engined training bomber and reconnaissance aircraft, as well as 13 DAR-8 and 26 KB-2A/3 trainers.

The best-known front-line aircraft produced by the indigenous aircraft industry was the KB-11 Fasan (Pheasant). In 1938 the VNVV issued specifications and development contracts for a single-engined short-range reconnaissance and close air support aircraft, powered by the 780-hp (582-kW) Alfa Romeo 126RC-34 radial. The aircraft would be required to operate on behalf of army division commanders. The two local companies – the Bojourishte-based DAR and the Kasanlak-based Bulgarski Caproni – were awarded with development contracts. The chief designer of the former, Professor Tzvetan Lasarov, developed the DAR-10A, a two-seat low-winged monoplane armed with two wing-mounted 7.92-mm and one turret-mounted 7.92-mm machine-gun, plus up to 500 kg (1,102 lb) of bombs. The aircraft, first flown on 2 July 1941, was suitable for both level and dive bombing, and during the flight tests it demonstrated very good performance. The maximum speed at sea level was 330 km/h (179 kt), and at 4000 m (13,123 ft) was 407 km/h (221 kt). The cruise speed at 4000 m was 330 km/h (179 kt) while the range was 1170 km (727 miles).

Bulgarski Caproni, headed by the Italian designer Carlo Caligaris, developed the KB-11 – a two-seat high-wing monoplane. The design of the first prototype, which was flown just once, was considered rather unsuccessful. The extensively redesigned second prototype made its maiden flight in 1941. Although inferior to the DAR-10 by all performance indicators, the KB-11 was eventually chosen as the winner in the competition and promptly launched into production. Featuring the same armament (two forward-firing and one turret-mounted defensive 7.92-mm machine-guns), the KB-11 was able to carry 400 kg (881 lb) of bombs. It had a top speed of 390 km/h (211 kt), cruise speed of 320 km/h (173 kt) and range of 650 km (404 miles). The VNVV eventually ordered 50. The last 10, produced in mid- and late 1942, were powered by the 837-hp (624-kW) PZL Bristol Pegasus radial. The KB-11s equipped one yato of 4/1 Orlyak of the 1st Rasuznavatelen Polk (RP), where the indigenous design replaced the S 328 in 1944, and with two yata of 1/1 Orlyak, replacing the PZL P.23.

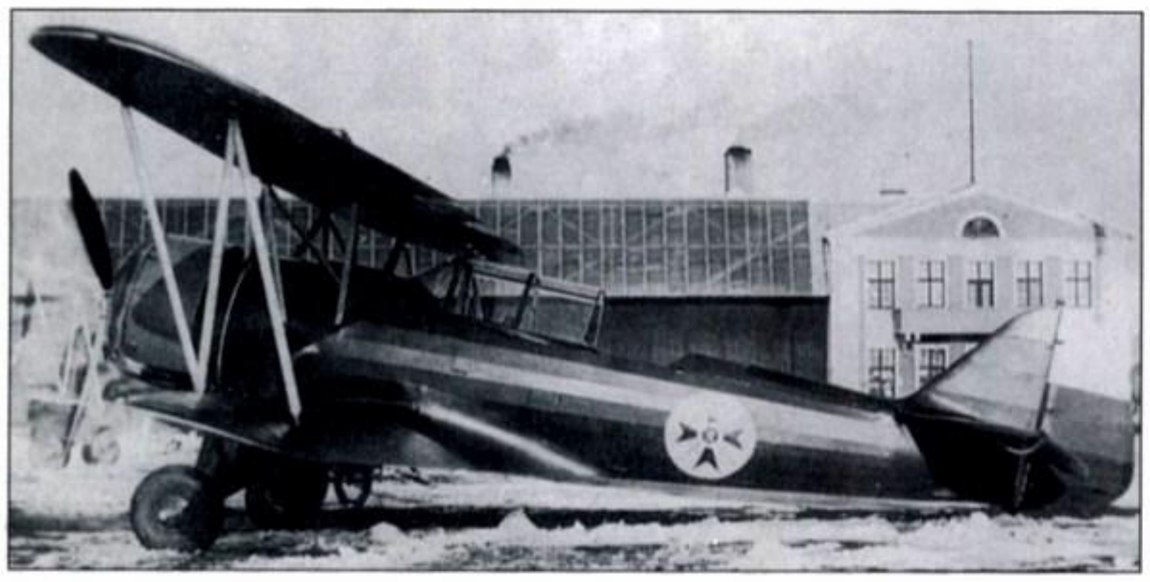
Unsuccessful DAR-10

Professor Lasarov, chief designer of the losing company DAR, decided to continue the work in order to improve his promising design. Sadly, the DAR-10A prototype aircraft was lost in a fatal crash in late 1941, but the professor promptly started the development of the new, significantly improved F version, powered by a 960-hp (716-kW) Fiat A74RC38 radial. It featured a top speed of 454 km/h (246 kt) and was armed with two 20-mm Oerlikon MG-FF cannon, two 7.92-mm forward-firing and one turret-mounted machine-guns, and up to 450 kg (992 lb) of bombs. The construction of the prototype was considerably delayed due to the busy repair schedule of the factory and a lack of certain construction materials. The aircraft finally made its maiden flight in March 1945, but by that time the DAR-10 design concept was considered rather obsolete and inferior to the Ilyushin Il-2, 120 of which were on order. The indigenous close air support aircraft thus lost any chance of entering production.

Another locally-produced significant design was the KB-6 (KB-309), a twin-engined multi-role aircraft derived from the Caproni Ca 309 Ghibli. It was used by the VNVV as a light transport, training, liaison and reconnaissance platform. Bulgarski Caproni produced a batch of 24 units for the VNVV, the first example of which took to the air on 28 November 1940.

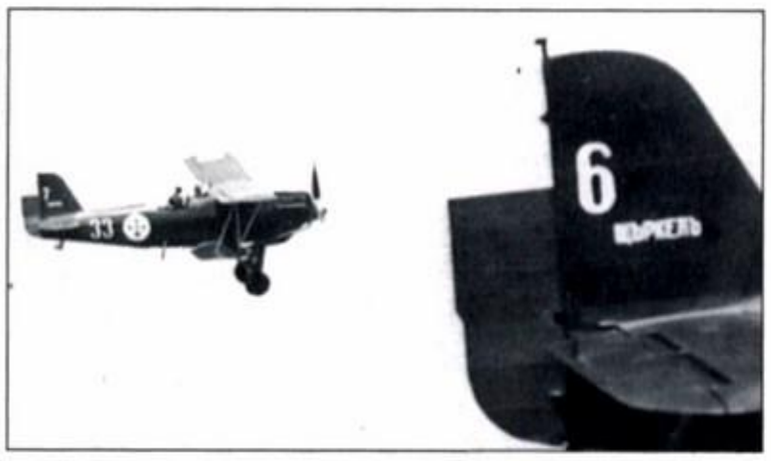
Vazdushni na Negovo Velichestvo Voyski (His Majesty's Air Force) Order of Battle, January 1940

UNIT	AIRCRAFT	BASE
Air Force Headquarters		***Sofia***
Front-line Units		
1st Battle Orlyak (wing)		***Bojourishte***
113th Yato (squadron)	P.23 (12)	
123rd Yato	P.23 (12)	
133rd Yato	P.23 (12)	
142nd Yato (training)	DAR-3 (3), KB-4 (6)	
2nd Fighter Orlyak		***Karlovo***
212th Yato	B 534 (15)	
222nd Yato	B 534 (15)	
232nd Yato	B 534 (15)	
242nd Yato	B 534 (15)	
253rd Yato (training)	B 122 (10), B 534 (10)	
Aerobatics School	B 122 (19), Ar 65 (12), He 51 (12), Bü 131 (6), Fw 56 (6)	
3rd Reconnaissance Orlyak		***Yambol***
313rd Yato	S 328 (12)	
323rd Yato	S 328 (12)	
333rd Yato	S 328 (12)	
343rd Yato	S 328 (12)	
373rd Yato (training)	DAR-3 (3), KB-4 (6)	
5th Bomber Polk		***Plovdiv***
515th Yato	B 71 (12)	
525th Yato	B 71 (12)	
535th Yato	Do 11 (12)	
545th Yato (training)	MB 200 (12)	
Instrument Flying School	Fw 58 (8), Ju 52 (2)	
Training Units		
Cadet Training Orlyak		***Vrazhdebna***
1st Yato	Fw 44 (20)	
2nd Yato	Fw 44 (20)	
3rd Yato	He 72, KB-3/-4, Fw 56	
3rd Training (Exemplary) Orlyak		***Stara Zagora***
1st Army Yato	He 45 (11)	
2nd Battle Yato	P.23 (9)	
3rd Fighter Yato	P.24 (11)	
Air School		***Kasanlak***
1st Training Yato	DAR-1A/-6, Bü 131, Fw 44	
2nd Training Yato	DAR-8, KB-2A, KB-4	
3rd Training Yato	KB-5, DAR-3, KB-5	



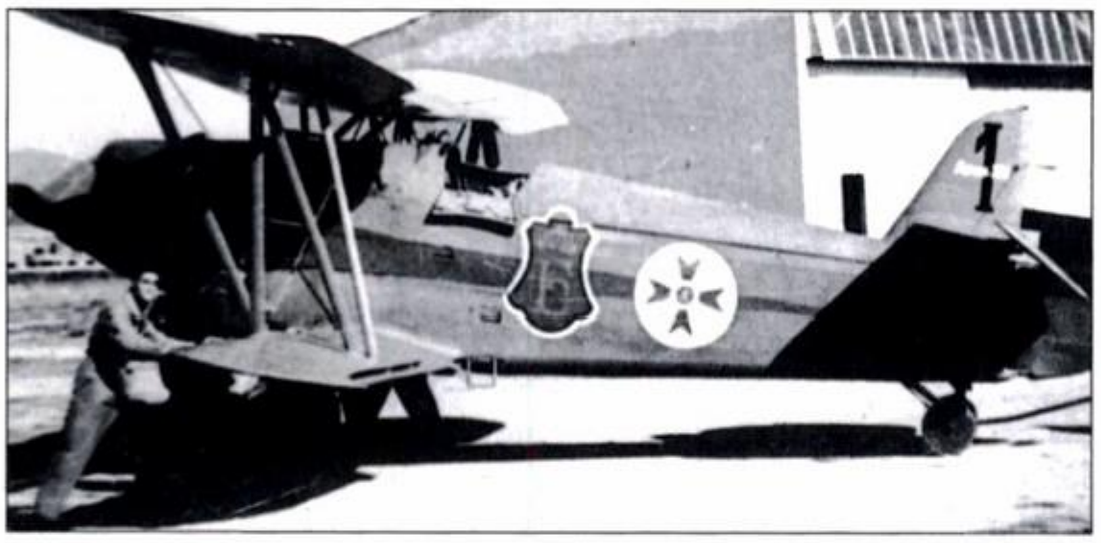
Left: A brand-new DAR-3 Garvan-III close air support and reconnaissance aircraft poses in front of the DAR factory at Bojourishte in early 1940.

Below: The DAR-3 Garvan-III was one of the few locally-produced combat aircraft. Twelve entered service in 1939 with the two army orlyaks and the flying schools.



Above: The first true reconnaissance aircraft, bought in late 1936 for the newly-formed air arm, was the Heinkel He 45A. Twelve served with the 2nd Army Orlyak until 1942.

Right: Twelve Arado Ar 65s, known locally as Eagles, were donated to the VNVV by its patron Tsar Boris III on 27 June 1937. In the early 1940s they were used as advanced and continuation trainers.



The last KB-6s were retired in 1946.

VNVV growth was particularly intensive between 1939 and 1941 as the total inventory increased from 212 to 550 units. As could be expected, the large variety of types – 36 with more than 60 versions, manufactured in four countries and using many different types of engines – caused serious maintenance and training problems. The accident rate also jumped sharply. The number of accidents increased from 48 in 1939 to 158 in 1940 and 142 in 1941. The fatal ones numbered eight, seven and 11, respectively; the hours flown numbered 28,231, 39,692 and 42,215, accumulated in 101,187, 120,805 and 114,600 sorties.

In mid-1940 a new organisational structure was introduced in anticipation of the inevitable war. The VNVV structure comprised headquarters, flying units, an air technical service of two maintenance centres based at Lovech and Karlovo, the State Aircraft Factory DAR at Bojourishte, parachute service and supply bases. The 1939-41 VNVV front-line organisation comprised two main elements – air units earmarked for independent operations and air units for army co-operation duties.

Expansion

On 1 July 1940 the existing six front-line orlyaks, formed between 1937 and 1939, were expanded to polk (division or air group) size. The units under direct VNVV control – the so-called Aviation of the Supreme Command – comprised the 5th Bomber Polk and 6th Fighter Polk. Each of these initially controlled two orlyaks with a total of five yata (squadrons), including one for training. The army co-operation assets of the air arm were grouped within four composite polks – 1st, 2nd, 3rd and 4th – each of which controlled two reconnaissance, one close air support and one fighter yato.

Main officer pilot and navigator training took place with the Junkerski Ucheben Orlyak (Cadet Training Wing) at Sofia-Vrazhdebna, which had on strength three yata, two equipped with 20 Fw 44s each and the third one with 42 aircraft of different types including He 72s, Bü 131s and KB-3s. The other training unit – the Air School, based at Kasanlak – was responsible for training of non-commissioned and reserve officer air crews. It had three component orlyaks: the 1st at Kasanlak, responsible for initial and basic flying training, the 2nd at Telish for instrument flying training, and the 3rd at Stara Zagora for advanced flying training. The Air School Polk had an inventory of 52 various aircraft.

A dedicated air defence service under VNVV control was formed in July 1940. It was initially equipped with eight batteries of 20-mm guns for low-level and four batteries of 88-mm guns for medium- and high-altitude air defence. The deployment of the AAA batteries around the country's capital and the other large towns commenced in early 1941.

By late 1940 the VNVV had an inventory of 595 aircraft (259 combat and 337 training/support aircraft) and personnel strength of 10,287, which represented 10.4 per cent of the total numerical strength of the Bulgarian armed forces. In late November all front-line aircraft adopted the new national insignia – the St Andrew's Crest, a traditional Orthodox symbol – following a 20 June War Ministry order. It replaced the old-style Bravery Crest, introduced in June 1937. The new insignia was applied on the rear fuselage and on the two sides of the wing. Stripes in white, green and red – the Bulgarian national colours – were applied on the rudder. The trainer fleet retained the pre-war pseudo-civil letter registration of the 'LZ-xxx' series.

War comes to the Balkans

On 23 January 1941 Bulgaria informally joined the Axis, thus allowing the 1-million strong Wehrmacht forces to enter the country to begin their preparations for the invasions of Greece and Yugoslavia from Bulgarian territory. A large number of Luftwaffe aircraft were deployed to Bulgaria in mid- and late March to take part in the Blitzkriegs against Yugoslavia and Greece which started on 6 April and 9 April 1941, respectively. In response to the surprise massive air and ground assaults, on 4

Bulgarian Air Force Chronology 1940-1949

1940

January Delivery of the last batch of 18 Avia B 534 biplane fighters to 2nd Iztrebitelen Orlyak at Karlovo thus raising the total number of the type to 78.

February 3rd Exemplary Training Orlyak of the Air School Polk formed at Sofia-Vrazhdebna.

1 February Air Warning Service formed within the VNVV structure.

May Delivery of 24 Arado Ar 96 trainers.

6 May An impressive flypast of 45 VNVV combat aircraft was staged over the centre of Sofia during the Armed Forces Day.

30 May The Bulgarian Parliament proclaimed the VNVV as the fourth separate arm of the national armed forces.

June Delivery of the first batch of 10 Messerschmitt Bf 109E-4 fighters and four Bf 108 conversion training aircraft to 6th Polk.

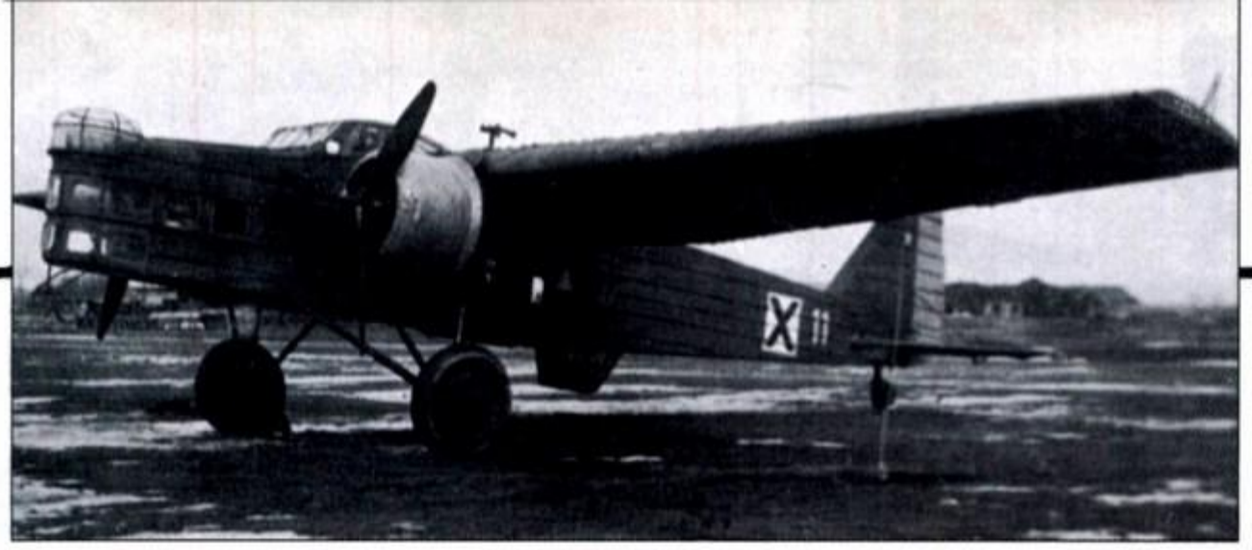
1 June The four existing anti-aircraft artillery units of the army were transferred to VNVV control. These comprised initially four heavy- and eight small-calibre AAA batteries, eventually equipped and declared operational in mid-1941.

1 July The four existing composite army co-operation orlyaks (wings) expanded to polk (division) size. The other two front-line orlyaks – 5th and 6th – remained under direct VNVV control and also expanded to polk size.

4 September The first four ex-Luftwaffe Do 17P bombers were delivered to the 5th Bomber Polk at Plovdiv. Two days later the remaining Do-17Ps of the first batch of 18 units were delivered to the newly-formed 4/5 Yato.

21 September Bulgaria regained the Southern Dobrudzha region lost to Romania after World War I. A temporary composite army orlyak of two S 328-equipped and one B 534-equipped squadrons temporarily deployed to the new territory at the airfield at Dobrich to support the ground forces.

23 November First VNVV dedicated air

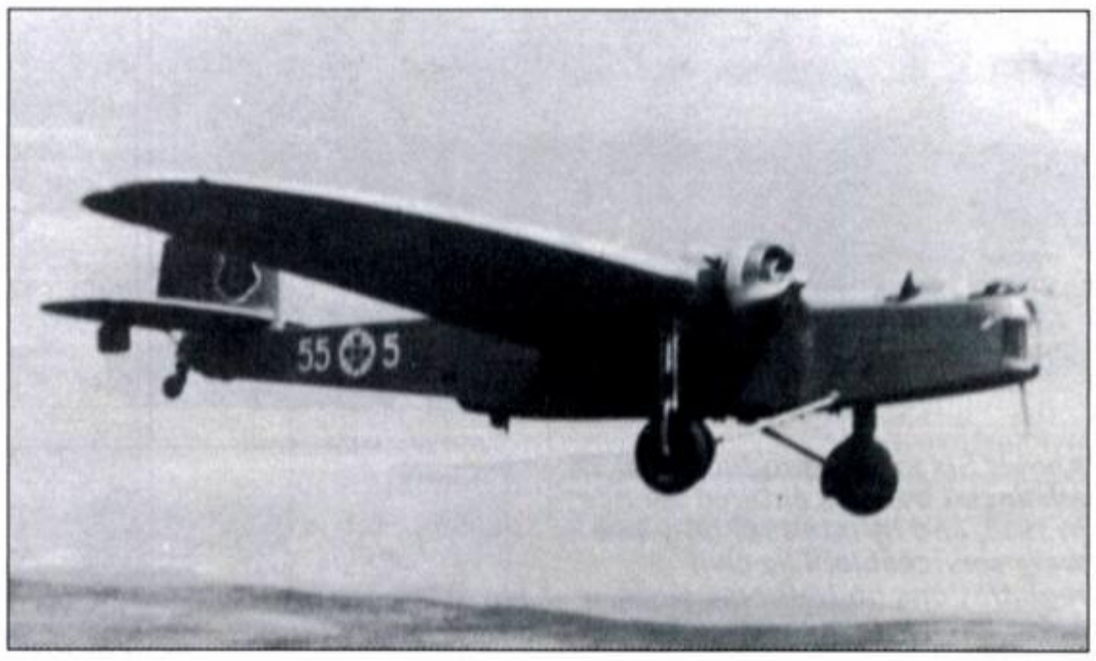


April Allied bombers mounted two night strikes against Sofia, followed by a third on 14 April. All the raids faced the resistance of the moderate AAA defending the capital, but no attackers were shot down.

The delivery of new aircraft and an intensification in flying training occurred in the spring of 1941. The first attempts to modernise the VNVV fighter inventory commenced in June 1940 with the delivery of the first batch of 10 Bf 109E-4s and four Bf 108B-1s, the latter used as conversion trainers for the 'Emil'. A total of 19 Bf 109E-4s, locally named Strela (Arrow), was bought in 1940 and 1941. The 'Emil' was used for training large numbers of fighter pilots of 3/6 Orlyak, who converted to the 'Gustav' in early 1943. The new aircraft were grouped in the newly-formed 'Strela' yato within the 3rd Orlyak of the 6th Polk at Karlovo.

The modernisation of the bomber force took place in September 1940 with the delivery of the first batch of 18 Dornier Do 17Ps. These were second-hand machines, actively used by the Luftwaffe during the French campaign of mid-1940. Dornier bought the Do 17s back from the Luftwaffe after the end of the battles and sold them to the VNVV after an overhaul. The new bomber received the local name Uragan (Hurricane). The first batch of 18 Do 17Ps was optimised for long-range reconnaissance, but they also retained full bombing capability and the Bulgarian technicians fitted them with Czech-made bomb racks. The Do 17Ps equipped 4/5 Yato (4th Squadron of the 5th Bomber Polk). Following the capitulation of Yugoslavia, Bulgarian troops captured a number of Do 17Ka-1s in Macedonia, a territory occupied by the 1st Bulgarian Army in April 1941. Six airworthy examples were ferried to Plovdiv in October 1941, where the booty aircraft underwent an extensive overhaul and entered service with the newly-formed 5/5 Yato. The total number of Do 17Ka-1s taken as war booty was 15, but only six were restored to flyable condition. The last batch, of 12 ex-Luftwaffe aircraft Do 17Ms, was delivered in September 1943.

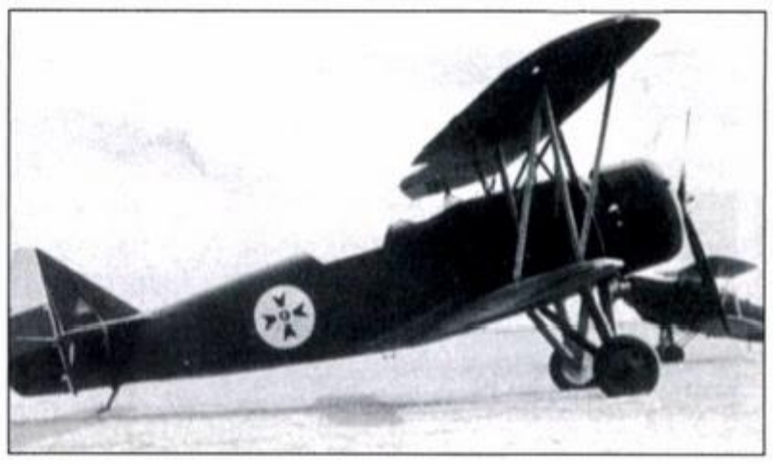
In June 1941, immediately after the start of the Soviet campaign, the Wehrmacht asked the VNVV to provide the anti-submarine defence of the 125-mile (201-km) long Black Sea coast-



Above: Twelve ex-Czechoslovak air force Aero MB 200 bombers were delivered in 1939. The type was a licence-built Marcel Bloch MB 200En-4.

The first true bomber of the Bulgarian air arm was the Dornier Do 11. By early 1940 these archaic machines were used only as transports.

Six DAR-3 Garvan Is, originally produced as reconnaissance aircraft in the mid-1930s, were used in the early 1940s in the liaison and flying training continuation roles.



Left: The Avia B 71 bomber was a licensed version of the famous Tupolev SB-2 bomber. Thirty-two units were delivered second-hand in 1939 to the 5th Orlyak, which was later expanded to the 5th Bomber Polk (regiment).

Below: The DAR-8 advanced trainer was used in dwindling numbers in the early 1940s. Six of the 12 aircraft built were considered serviceable in late 1941.

defence exercise conducted, involving all fighter, AAA and early warning units.

25 November A new national insignia – the St Andrew Crest – was adopted, replacing the red Bravery Crest introduced on front-line aircraft in 1937. This comprised the St Andrew Crest on the fuselage and under the wings as well as white-green-red stripes on the rudder. The training fleet retained the old-style pseudo-civil letter registration of the 'LZ-xxx' series.

28 November First flight of the KB-309 prototype aircraft, coded 118, a derivative of the Caproni Ca 309 Ghibli, produced by Bulgarski Caproni at Kasanlak. A total of 24 was built in 1940 and 1941.

26 December Tsar Boris III sent the VNVV C-in-C Maj. Gen. Boydev on a visit to Romania in order to study the war plans of the neighbouring state and future Axis partner.

Late 1940 Twelve Avia B 135 fighters were ordered. These were the first batch to be assembled locally, followed by licence-manufacture of the fighter under the DAR-11 designation.

First flight of the KB-11 prototype, designed under the VNVV contest for close-range reconnaissance and close air support aircraft.

1941

1941 The number of sorties flown by the VNVV during the year reached 114,600; the hours flown – 42,215; the accidents – 114, of which 11 were fatal.

Early 1941 First flight of KB-11 second prototype, close to the production standard which won the VNVV contest for close-range reconnaissance and close air support aircraft later in the same year.

23 January Bulgaria officially declared its intention to join the Axis

2 February Wehrmacht units entered Bulgaria. A total of 680,000 German troops deployed in the country in anticipation of the spring offensives against Greece and Yugoslavia. Luftwaffe units of VIII. Fliegercorps were based at four main airfields in Bulgaria.

March The Gunnery School of the 2nd Training Orlyak of the Air Training Polk moved to Balchik airfield.

1 March Bulgaria signed a formal agreement for joining the Axis.

5 March Britain ceased diplomatic relations with Bulgaria.

Above: Six locally-produced KB-2A advanced trainers entered service in 1936, and by late 1941 only two were serviceable. The civil registrations on trainers were a guise to circumvent restrictions on military aviation.

Right: The Heinkel He 72 was used for initial and basic flying training with the Officer Training Orlyak at Vrazhdebna in early 1940s and later with the Fighter School.

Below: Avia B 122 aerobatic trainers were used in the early 1940s by the Fighter School for introducing student pilots to the art of air combat.

Above: Twelve Bücker Bü 131 Jungmanns were used for initial flying training with the Kasanlak-based Air School in the early 1940s.

line. Sea reconnaissance and ASW on behalf of Axis shipping in Bulgarian territorial waters initially were provided by an independent yato, with crews and aircraft drawn from both the 2nd and 3rd Polks. It was equipped with nine S 328s – four based at Balchik and the rest at Saraphovo near Bourgas. The unit received its daily tasking from the Black Sea Kriegsmarine Command, headquartered in Varna – the largest Bulgarian Black Sea town and also the most important port. The main task of the unit was search and attack on Soviet submarines in Bulgarian territorial waters, and searching for minefields and floating mines laid by the subs in the entrance to the ports of Varna and Bourgas. If weather permitted, one aircraft would patrol over each Axis convoy sailing towards the Bosphorus straits along the Bulgarian coastline.

From 6 August to 31 December the S 328s of the yato, and later the aircraft of the reconnaissance orlyak of the Black Sea Air Defence Command, flew 68 combat missions with a total of 173 sorties. Forty-one were dedicated to air cover of convoys, solo ships and minelaying operations. Twenty-three missions were carried out for submarine and mine reconnaissance. S 328s made five contacts with Soviet Black Sea Fleet submarines, the first on 16 August. On 15 October 1941 the most successful action occurred, in which an escorting S 328 attacked with two 20-kg bombs a Soviet submarine trying to attack an Axis convoy near Varna. According to the crew report, two direct hits were observed, followed by rapid diving of the target. The usual oil splash did not appear, so there was no confirmation of the success of the attack. According to information supplied by post-war Soviet historic sources, the 'Malutka'-class submarine *M-58* was lost to an unknown cause near the site of the last air attack between 18 and 20 October. There is a high probability that the *M-58* was destroyed or at least damaged in the 15 October airborne attack.

Black Sea command

On 1 October 1941 the VNVV formed the Black Sea Air Defence Command, headquartered at Tchaika naval air station in Varna. The Command had one air unit, the 'Galata' fighter orlyak with three component yata – the 682nd and 692nd, equipped with five or six Bf 109E-4s each, and the 442nd with six B 534s. It was based at the airfields of Balchik (682nd) and Novogradetz (442nd) near the Romanian border and at Saraphovo (692nd) on the southern part of the coastline. The S 328-equipped patrol unit was expanded to orlyak size. Early warning of incoming hostile aircraft was provided by the Varna-based Luftwaffe air surveillance radar.

Immediately after the Greek capitulation, the Bulgarian 2nd Army entered the northern regions of Greece, establishing garrisons in the Aegean region of Thracia. Another newly-joined territory was Macedonia, part of the occupied Yugoslavia, with a significant population of ethnic Bulgarians.

The Bulgarian Supreme Command's main concern in the spring and summer of 1941 was the behaviour of Turkey, the sole remaining neutral neighbour in the south – and a long-standing enemy. Several VNVV light bomber and reconnaissance units were urgently rebased at forward airfields along the Turkish border in early April. In early May, the 443rd Yato, equipped with four S 328s, was moved from its permanent base at Gorna Oriahovitza to Badem Chiflik on the Aegean coast. It was tasked with air reconnaissance along the Turkish border and the Aegean coast in order to reveal preparations by either Turkish or Allied forces for any offensive operations. The unit actively participated in suppressing the Drama uprising from 29 September to 5 October 1941, flying numerous reconnaissance, liaison and attack missions.

In late July the 443rd Yato was supplemented by a composite bomber orlyak of two yata, one equipped with seven Do 17s and the other with six B 71s. The aircraft and crews were drawn from the Plovdiv-based 5th Polk. Two of the B 71s collided in mid-air on their ferry flight to Badem Chiflik, resulting in the fatal crash of one of the bombers and the safe landing of the other. During their long-lasting deployment, the Do 17s and the B 71s were tasked with daily maritime patrol missions from the littoral waters of the Greek Aegean coastline – from the straits of the Dardanelles in the east to the island of Crete in the west. The main patrol activities included submarine search, control of all shipping in the Aegean Sea, photography of the mine fields laid by British submarines in the straits and surveillance of the Turkish fleet. The range of tasks was later extended to the escort of Axis (mainly Italian-owned) ships and convoys used to supply Wehrmacht units in North Africa. They were dispatched from the

6 April Von Kleist's panzer divisions mounted a mass assault against Yugoslavia from Bulgarian territory. The first bombing raid on Sofia followed the same day by a sole Yugoslavian Do 17K, to which air defence reacted inadequately. In the night, RAF bombers attacked a number of targets in Bulgaria including Sofia.

15 April Second RAF night bombing raid on Sofia. AAA reacted in time but was ineffective.

19 April Bulgarian ground forces, in the form of the newly-formed 5th Army, deployed to Macedonia and southern Serbia. The 113th Army Yato of the 1st Polk deployed to Skopje airfield in Macedonia in order to provide support to the 5th Army.

20 April The 2nd Army established control over the abandoned Metaxas Line and the Thracia region of Greece. Two weeks later a flight of four S 328s of the 4th Orlyak deployed to Badem Chiflik airfield near Kavala for reconnaissance of the Aegean coastline and the shore waters.

21 June The Reich's military mission in Sofia requested Bulgaria's participation in Aegean Sea shipping defence. The same day, the VNVV C-in-C ordered the 5th Bomber Polk to handle this responsibility.

30 June The newly-formed composite orlyak of the 5th Bomber Polk – with seven Do 17s and six B 71s – deployed to Badem Chiflik airfield on the Aegean coast.

July Lovech Technical Centre was formed within the VNVV's structure.

2 July First flight of DAR-10A close air support and reconnaissance aircraft.

3 July The Reich's military mission in Sofia asked the VNVV to deploy a squadron of nine aircraft for anti-submarine defence of German shipping in the Black Sea.

Six Focke-Wulf Fw 56A-1 Stössers were used for initial and basic flying training with the Fighter School in the early 1940s.

Below: The PZL P.43B Karas attack/recce aircraft was the first combat type procured in large numbers, due to its low cost. A total of 50 aircraft served from 1938 to 1944 with the VNVV.

Black Sea ports in Bulgaria and Romania. In the event of discovering intentional scuttling of Italian ships by their crews, who might have been unwilling to continue their participation in the war, the pilots were ordered to immediately attack the life-boats which the Italians used to reach neutral Turkey.

The ASW and anti-landing patrols off the Aegean coast intensified in late 1941 and 1942, as by that time the Wehrmacht Aegean Command was expecting a large-scale Allied landing in the region, between the mouths of the Maritza and Struma (Strumon) rivers, territory controlled by the Bulgarian Army.

Crisis at Drama

The Do 17s and the B 71s of the Aegean composite orlyak were often used in anger, initially against Greek-operated smuggling vessels sailing near the mouth of the Maritza River, where the Reich retained a territory under Greek administration. The air patrol regularly mounted strafing attacks on vessels of local smuggling bands sailing under the Greek flag off the mouth of the Maritza near the Turkish border. The hottest combat actions for the orlyak came during the suppression of the Drama uprising in late September and early October 1941. The rebels, well equipped with weapons abandoned by the Greek army at the Metaxas Line in April 1941, launched fierce attacks on the Bulgarian garrisons in Seres and Drama. The Do 17s and the B 71s were used for close air support of Bulgarian troops during their offensive, mounting 14 devastating bombing missions against rebel strongholds in villages around Drama.

In March 1942 all VNVV front-line fighter and bomber units were gathered within the Vazdushna Escadra (Air Group). This Air Combat Command-like structure controlled the 2nd Lineen (Battle) Polk (later renamed the 2nd Attack 'Stuka' Polk), 5th Bombard-irovachen Polk and 6th Iztrebitelen Polk. The 1st Rasuznavatelen Polk was placed under the direct control of the VNVV headquarters. The other direct-reporting air units were the Prenosno Yato (Air Transport Squadron) and the Flying School.

The renewal of of the fighter force began in early March 1943 when 3/6 Orlyak of the Karlovo-based 6th Polk received the first of 23 brand-new Bf 109G-2s. They re-equipped the three yata and the staff flight of the orlyak. The unit reached initial operating capability in July, just in time to launch the first VNVV air combat against Allied bombers on 1 August. Some 145 'Gustavs' were delivered to the VNVV in 1943 and 1944. The other fighter units – 1/6 and 2/6 Orlyaks – each had a total of six combat and two training squadrons, equipped with about 60 B 534 biplane fighters. By 1943 the B 534 was finally considered obsolete in the fighter role and a replacement was urgently sought. In February 1943 the government approved a contract calling for delivery of 20 Bloch MB.152 fighters, but the deal never materialised due to a German veto.

The capability of the VNVV fighter force was eventually boosted with the procurement of 96 second-hand Dewoitine D.520s. They were initially intended to be employed for the air defence of the Reich, but in August 1943 the fighters were sold to Bulgaria. One hundred units were to be delivered in September, followed by 24 more later that year. In reality, 96 D.520s were eventually delivered, equipping 2/6 and 4/6 Orlyaks which began conversion in November at Karlovo. Several examples were locally modified to a twin-seat conversion trainer configuration after a number of accidents, most of them fatal, during the early days of the pilot familiarisation course.

The Bf 108B-1 entered service with the 6th Iztrebitelen Polk in June 1940 and was initially used to ease Bf 109E-4 pilot conversion. Six examples were eventually delivered. After the war the survivors were used as liaison and VIP transport aircraft.

Popular Dewoitine

Often dismissed as being rather obsolete and impotent in its main fighter role, the D.520 was actually a relatively good air defence fighter, able to fight well against all types of Allied bombers and escort fighters operating against Bulgaria. Featuring easy handling, a powerful Hispano HS 404 20-mm gun and reliable powerplant, the French-made fighter quickly became popular with Bulgarian pilots. The lack of tactical knowledge by VNVV commanders, however, prevented the effective use of the fighter assets during the air defence of Sofia, leading to the relatively poor results achieved by the D.520-equipped orlyaks in comparison with the Bf 109G-equipped ones between November 1943 and September 1944. According to official VNVV records, D.520 pilots scored a total of 14 confirmed kills – three P-38s and 11 bombers, among them five B-17s, two B-24s and one Stirling B.Mk II. This represented 26.4 per cent of the confirmed kills of all VNVV fighters from August 1943 to September 1944.

The Czech-made Avia B 135 was the third fighter type, initially intended to be procured in large numbers. First flown in 1938, the B 135 was supposed to become the main fighter type of the Czechoslovak air arm. In fact, Bulgaria was the sole user of the B 135, ordering a batch of 12 units in 1940. They were manufactured by Aero in 1942-43 and delivered in kit form to the VNVV's State Aircraft Factory DSF, the former Bojourishte-based DAR which moved to the city of Lovech in late 1941. The factory began preparation for licensed production of

4 August A composite yato of five S 328s from the 2nd Polk formed at Balchik. Another yato of four S 328s from the 3rd Polk formed at Saraphovo airfield. Both were tasked with anti-submarine defence of the German convoys sailing in Bulgarian territorial waters on their route towards North Africa.

11 August The VNVV's C-in-C Maj. Gen. Boydev was replaced by Maj. Gen. Iranov.

13 September The largest exercise of the Bulgarian Armed Forces took place, dealing with offensive and defensive operations towards the Turkish border.

October Delivery of six ex-Yugoslavian Do 17Ka-1 bombers taken as war trophies by the Bulgarian Army in Macedonia. A total of 15 units was eventually taken on strength but only six were restored to serviceable condition.

1 October Black Sea Air Defence Command formed, comprising the 'Galata' fighter orlyak, headquartered at Varna with three component squadrons at Balchik (five/six Bf 109Es), Saraphovo(five/six Bf 109Es) and Novogradez (six B 534s). The orlyak was later transferred to the direct control of the Luftwaffe Black Sea air defence command.

20 October The composite army orlyak at Buhovtzi disbanded.

December Start of operations at the VNVV's Lovech Technical Centre. Its main activity comprised the production of the DAR-9 trainer aircraft, an Fw 44 derivative.

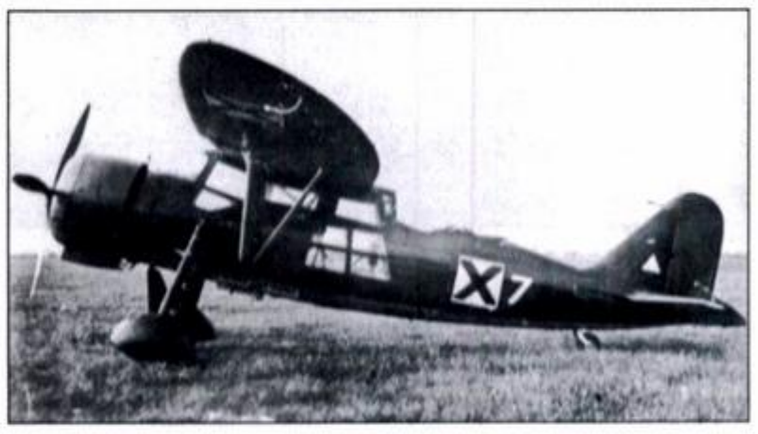
13 December Bulgaria declared war on both Britain and the US.

Above: A KB-11 seen in September 1944 wears the Patriotic War white band around the rear fuselage. The nine aircraft of 4/1 Orlyak were used for close-range reconnaissance in the Macedonian theatre in late 1944.

Below: The most numerous combat type of indigenous design was the Caproni Bulgarski KB-11 'Fasan'. Fifty aircraft were built, of which 30 were transferred to Yugoslavia as reparations payment after the end of the war.

Above: Twenty-four KB-6 twin-engined multi-role aircraft were used in liaison, reconnaissance and training roles.

Left: Some 28 KB-4 advanced trainers and liaison aircraft were produced in 1938 and 1939. Several were used in second-line roles during the 1944 war against the Third Reich.



the B 135 under the local designation DAR-11, but this never materialised. The need for more and more new front-line aircraft for the Luftwaffe by that time required the mobilisation of all RLM factories in the occupied territories, including Avia. Only 12 B 135s of the first batch were eventually produced, powered by the 860-hp (642-kW) Hispano-Suiza HS12Ycrs engine. The dozen aircraft were assembled by the DSF in the summer of 1943 and the first B 135 was handed over on 28 August. The VNVV eventually decided to use the 12 B 135s only as training fighters so they were assigned to the Fighter School of the 6th Polk, based at Dolna Metropolya in central northern Bulgaria. Because the B 135 had rather demanding handling, they were flown only by the school's instructor pilots, all of them experienced fighter pilots serving with the school on a temporary basis. They highly prized the aerodynamic qualities of the B 135, but generally considered the fighter too underpowered. The intended armament of one motor-mounted 20-mm HS 404 cannon with 60 rounds and two synchronised 7.92-mm VZ.30 machine-guns was reduced to only the VZ.30 pair, as no cannon were available for the first B 135 batch. For this reason, front-line use of the dozen B 135s was almost impossible.

The weak armament did not prevent four B 135s, led by the school's commanding officer, Captain Atanasov, to mount an unauthorised air defence mission over Sofia on 30 March 1944. The four fighters attacked the last wave of B-24 bombers on their return leg. The first firing passes were ineffective but later the lead pair managed to catch a lone Liberator. Spending the last rounds of their two 7.92 mm machine-guns and using their last fuel, the Bulgarian pilots were eventually able to damage the two engines on one of the wings of their victim. The badly-damaged B-24 lost height and, according to pilot reports, crashed in a mountainous zone in Serbia. Its wreck was impossible to find for confirmation because the area was controlled by Serbian Communist guerrillas and no Bulgarian ground troops were able to operate safely there at that time.

In late 1941 the VNVV Command set up a dedicated naval aviation unit, tasked with maritime reconnaissance, ASW, anti-mine and anti-ship duties. On 29 September 1942 the 161st Vodosamoletno Yato (VSY – Floatplane Squadron) within the 1st Rasusnavatelen Polk was formed with an initial inventory of two He 60B-2 and two He 42 floatplanes, used for the training of the first cadre of Bulgarian naval aviators. The flying training, in which German instructors were involved, was completed by the end of 1942. The unit was based at Tchaika, a World War I-era naval air station on the shore of Varna Lake, close to the main base of the Bulgarian Navy.

The DAR-9 was the main initial trainer of the Kasanlak-based Air School in the mid-1940s and then of the People's Air School at Sofia and Dolna Metropolya. A total of 42 was produced between 1940 and 1942.

Naval floatplanes

The 12 Arado Ar 196A-3 patrol floatplanes were delivered in April 1943. The A-3 version was a modern and very capable naval combat aircraft, successfully used by the shore-based ASW and Luftwaffe coastal defence units. The 161st VSY was declared operational by mid-1943, tasked with the daily reconnaissance of Bulgarian territorial waters in addition to occasional air and ASW cover of Axis convoys heading towards the Bosphorus. Maritime reconnaissance was done at a range up to 150

1942

January 1st Occupation Corps in Serbia formed, replacing Wehrmacht forces stationed there since April 1941. Air support of the corps was provided by a composite yato of six S 328s, based at Nish.

The composite bomber orlyak and the 443rd yato at Badem Chiflik airfield transferred under the control of the newly-formed Bulgarian Aegean Defence Command.

March Air Escadra – a front-line air command – was formed to control the 2nd, 5th and 6th Polks, into which the VNVV fighter and bomber assets were grouped.

28 March Fighter School of the 6th Polk moved from Karlovo to Dolna Metropolya.

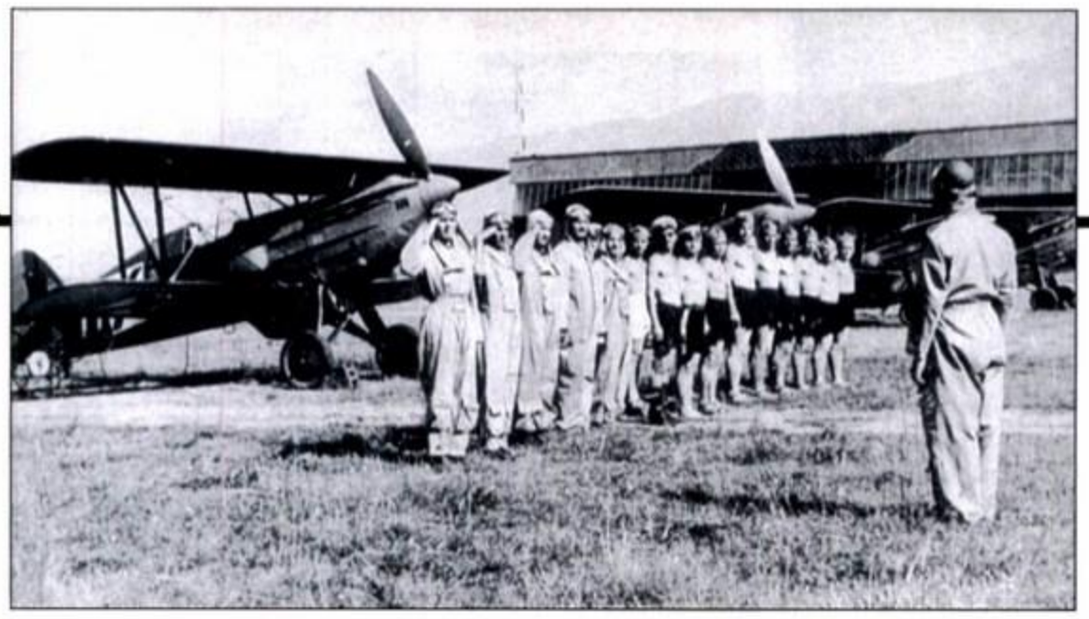
22 June The air defence of Sofia strengthened, with a total of 14 B 534 fighters of 1/6 Orlyak, moved to Bojourishte and was placed under the direct control of the VNVV C-in-C.

31 July VNVV Air Warning Service reorganised into three main units stationed at Bojourishte, Stara Zagora and Gorna Oriahovitza.

15 September Bulgarian government bought the Bulgarski Caproni aircraft factory and transferred it under the VNVV control.

29 September 161st Vodosamoletno Yato (Floatplane Squadron) formed at Varna. Late in the year it was transferred under the control of the 1st Rasuznavatelen Polk (RP).

November Two He 60 floatplanes



Above: The Avia B 534 played a very important role in the building-up of the Bulgarian fighter force as it allowed hundreds of pilots to gain significant experience between 1940 and 1944.

Right: In early 1944 the surviving B 534s were transferred to 2/2 Orlyak and used with considerable success against Wehrmacht troops, artillery and vehicle convoys during the battles in Macedonia between September and December 1944.

Below right: The Avia B 534 became the main VNVV fighter type in 1940 as 78 examples were taken on strength. They equipped the four squadrons of the 2nd Iztrebitelen Orlyak at Karlovo which later expanded to the 6th Iztrebitelen Polk (fighter division).

miles (240 km) from the coastline at an altitude of 200-300 m (656-984 ft). The main purpose of these missions was to search for Soviet submarines and surface vessels which could threaten shipping in the western part of the Black Sea. Searching for floating mines – separated from their anchors or newly laid by Soviet submarines on the approaches to the ports of Varna and Bourgas – and destroying them was another daily task. The two wing-mounted 20-mm Oerlikon MG FF cannon were the main weapons used for the destruction of these mines.

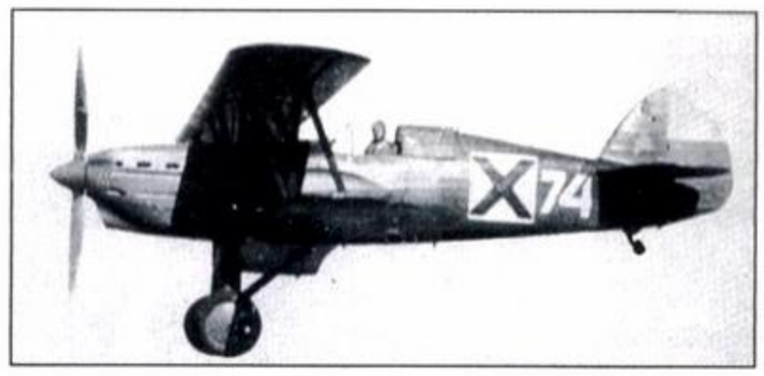
Stukas for the VNVV

The next wave of re-equipment of the VNVV ground attack forces began in the summer of 1943 with the delivery of the first batch of 12 second-hand Junkers Ju 87R-2 Stuka bombers to the Graph Ignatievo-based 1/2 Orlyak of the 2nd Polk. They were initially intended for the anti-shipping role, as by that time an Allied landing was expected on the Aegean shore and the Bulgarian Army and VNVV were to play the main role in the coastal defence. The next Stuka batch of 13 Ju 87D-5s arrived in January 1944, followed by a third of 19 more D-5s, all them second-hand, thus establishing a total Stuka fleet of 44 machines. Eight more ex-Luftwaffe D-5s were delivered in mid-1944 to help equip 1/2 'Stuka' Orlyak, comprised of three combat squadrons with nine Ju 87D-5 each, plus three Stukas assigned to the staff flight. The R-2s equipped the orlyak's training squadron. The Bulgarian pilots, drawing on extensive experience of the PZL P.43 and the S 328 and the help of their Luftwaffe instructors, rapidly mastered the dive-attack profile of their potent new mounts. The unit's first use in anger was against Communist insurgency groups in the Balkans in central Bulgaria in the summer of 1944. By the start of operations against the Wehrmacht in September 1944, the aircrews had a high level of operational training.

The situation in the Balkans rapidly deteriorated in mid-1943 when the US 9th Air Force began its raids on the oil fields and refineries in Romania. Late in the year the Allies launched large-scale raids on Sofia and other large Bulgarian towns.

Against the American bombers

The first air combat between Bulgarian fighters and US bombers (165 B-24 Liberators, with no fighter escort) took place on 1 August, when the 9th Air Force began Operation Tidal Wave directed at the suppression of oil production in the Ploesti region of Romania. The 6th Air Polk scrambled its alert force of 10 B 534 fighters of 1/6 Orlyak, based at Bojourishte and Vrazhdebna, and 10 Bf 109G-2s of 3/6 Orlyak at Karlovo. They were not able to engage the enemy on its way toward Ploesti, but on the return leg the Bulgarian fighters attacked two Liberator groups. As could be expected, the archaic B 534s were not able to achieve any success, but a flight of four Bf 109G-2s intercepted a group of about 20 Liberators over northern Bulgaria. Their firing passes resulted in the downing of five B-24s, including the lead



Below: When Bulgaria turned against its former ally Germany in September 1944, attack-tasked B 534s received a new, dark green camouflage with hastily applied mottling, white fuselage band and wingtips.

Avia B 534

This B 534 of the 2nd Fighter Orlyak in 1941-42 was finished in Luftwaffe dark green over light blue. The Bulgarian national colours appeared on the rudder and the number '2' was repeated on the top of the upper wing and beneath the lower wing.

delivered second-hand to the newly-formed 161st Floatplane Yato based at Tchaika naval air station near Varna.

December A VNVV report put the personnel strength of the air arm at 7,691, and the aircraft inventory at 609.

1943

January Bulgarian War Minister Lt Gen. Mikhov visited the Reich for talks on the delivery of modern arms. The resulting Barbara Plan for re-equipment of the VNVV called for delivery of 27 Bf 109G-2s, six Do 17Ms, 18 Fw 198A-2s and 12 Ar 196A-3s.

January Establishment of the dedicated air defence structure within the VNVV complete.

1 January DSF aircraft factory at Lovech transferred under the control of the War Ministry.

19 February A contract for delivery of 20 Bloch 152s approved by the government but the deal never materialised.

March Delivery of the first batch of 23 Bf 109G-2s delivered to 3/6 Orlyak at Karlovo.

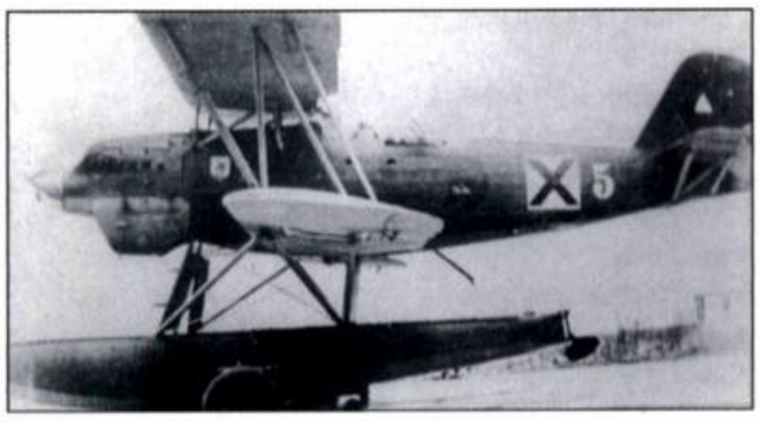
Delivery of 12 Avia B 135 fighters in kit form to the DSF factory at Lovech for assembly.

April Delivery of 12 Ar 196A-3 floatplanes to the 161st Yato at Tchaika naval air station.

The elite 3/6 Orlyak received its first 10 Bf 109E-4s in June 1940. In October 1941 the fighters were employed in the air defence of the Black Sea coastline serving with the 682nd and 692nd yata. Bf 109Bs were also used as trainers.

Above right: A few camera-equipped Bf 109G-4s were delivered in exchange for G-2s and G-6s sent for overhaul to Romanian factories.

Above: A total of 12 Fieseler Fi 156s was taken on strength with the staff flights of the main front-line units between 1941 and 1943. Some were later assigned to the supreme command and to the escadra.



The initial inventory of the 161st VSY (Vodosamoletno Yato - floatplane squadron) comprised two ex-Luftwaffe Heinkel He 60B-2s, delivered in late 1942.

aircraft, which fell as the first victim of the battle in a deliberate head-on attack mounted by the most successful Bulgarian fighter pilot – Poruchik (Lieutenant) Stoyan Stoyanov. The wreck of a sixth Liberator, for which nobody claimed responsibility – it was probably heavily damaged by either Luftwaffe fighters or AAA over Ploesti – was also found on Bulgarian territory. For his brave leadership and the double B-24 kills, the leader of the group, Poruchik Stoyanov, was awarded the Bravery Cross.

On 12 August the most potent Bulgarian fighter unit – 3/6 Orlyak, equipped with 16 Bf 109G-2s – was deployed to Bojourishte, assuming the responsibility for the air defence of Sofia. The ground-based air defence of the capital was strengthened to 56 88-mm AAA guns, by late 1943.

The Wehrmacht contributed to the air defence of the territory of its Axis partner by establishing air surveillance and an early warning radar network, with its main control centre at Boyana, a village near Sofia. Also at Boyana was the headquarters of the Luftwaffe main air defence control centre in the Balkans, responsible for the control of the fighter Jagdgruppen defending the strategically important oil fields around Ploesti. The main Wehrmacht air defence assets – fighters and heavy-calibre AAA – were grouped in the Bucharest-Ploesti region. The air defence of Sofia was assigned to the 6th Polk alone, which had no more than 60-70 serviceable fighters at any time. It must be mentioned that, although Bulgaria was an Axis partner, it was not until the summer of 1944 that the Bulgarian Supreme Command ordered the VNVV to intercept the Allied bomber formations heading toward Ploesti through Yugoslavian airspace and in the extreme northwestern corner of the Bulgarian territory. The Allied bombers were intercepted only if they were heading toward Sofia or other large Bulgarian towns, as they often dropped their remaining bombs on Bulgarian territory.

In October, 18 B-25s and a number of P-38s bombed the Skopje railway terminal. Two Bf 109 pairs of 3/6 Orlyak were promptly rebased at the Skopje airfield to serve as an ambush element and as an airborne early warning post for Sofia's air defence. On 21 October one of the pairs was scrambled to engage a group of 20 P-38 fighters approaching to attack Skopje rail station, and in the ensuing combat one P-38 was shot down.

Operation Point Blank

In the autumn of 1943 the Allies launched the Point Blank strategic air offensive against the Reich and its partner states. The main Point Blank aim in Bulgaria was that bombing would cause severe political instability followed by a prompt break with the Axis, thus denying the already battered Wehrmacht the use of Bulgarian bases and resources. The main target was Sofia, on which 10 large-scale bombing raids were launched from 14 November 1943 to 17 April 1944 by the Italian-based 15th Air Force. The first of the raids took place on 14 November with the participation of about 90 B-25 bombers, escorted by 100 P-38s. They approached their targets by 12.25, in two waves of about 45 aircraft each, flying at 6,000 ft (1828 m). The VNVV early warning service delayed issuing the reports on the enemy approach by at least 10 minutes, causing the fighters to scramble late. The first Bf 109G-2s of 3/6 Orlyak got airborne when the first of the attackers were just about to drop their bombs. The AAA batteries mounted a strong opposition, firing 846 rounds and managing to force the bombers to deviate from the city centre. Thirteen Bf 109G-2s engaged the escorting Lightnings, which blocked their way to the bombers. Only one kill was confirmed, while one Bf 109 and pilot were reported lost, in addition to two fighters heavily damaged in belly landings.

Ten days later the second raid followed, and this time the early warning reports were issued in time. Thirteen Bf 109Gs were scrambled. After forming up at 23,000 ft (7010 m), off the Vitosha mountain, the fighters headed south to mount an upward, head-on attack on the lead element of 18 B-24s. The fighter attacks were followed by the fire of the heavy-calibre AAA. The strong resistance and the presence of broken clouds over Sofia forced the Liberators to drop their bombs other than on their assigned targets; only 17 B-24s were able to drop bombs inside the city perimeter. The Bulgarian fighters repeated their passes on the disrupted bomber groups on their way back, scoring several confirmed and probable kills. The wrecks of two B-24s were found on Bulgarian territory, but the BBC in London, as Bulgarian historians note, reported 10 losses. 3/6 Orlyak itself lost one pilot and three aircraft, while three more pilots were forced to make (successful) belly landings due to extensive battle damage.

The third air raid took place on 10 December. The bomber formation of 50 B-24s, escorted by about 60 P-38s, plotted its route toward Sofia using the same time and flightpath

May Some 17 VNVV pilots sent for advanced training to the Luftwaffe flying school in Thessaloniki in Greece.

1 July An aircraft repair factory was formed at Skopje airfield in Macedonia.

August Delivery of 12 Ju 87R-2s to 1/2 Orlyak at Graph Ignatievo.

1 August First encounter of the VNVV fighter force with Allied bombers in Bulgarian airspace. Five USAAF 9th Air Force B-24s reported shot down during the first combat.

12 August The elite 3/6 Fighter Orlyak deployed to Bojourishte airfield with its inventory of 16 Bf 109G-2s to strengthen the capital's air defence.

August 28 Twelve locally-assembled Avia B 135 fighter taken on strength by the VNVV and assigned to the Fighter School at Dolna Metropolya.

August 28 VNVV's patron Tsar Boris III died, cause unknown.

September The last batch of 12 ex-Luftwaffe Do 17Ms delivered to the 5th Bomber Polk at Plovdiv.

September Some 96 D.520 fighters delivered to 2/6 and 4/6 Fighter Orlyaks at Karlovo, replacing the B 534 biplanes.

19 October A Bf 109 pair of 3/6 Orlyak deployed at Skopje airfield to serve as a forward airborne early warning post and an ambush element within the air defence of Sofia.

14 November First large-scale air raid on

The second 'Gustav'-equipped fighter unit was 2/6 Orlyak which received its G-6s in January 1944. A total of 145 newly-built Bf 109G-2/4/6s was delivered to Bulgaria in 1943 and 1944.

The most prominent VNVV pilot of the World War II-era was Capt. Stoyan Stoyanov, Hero of the Air Escadra. Stoyanov is credited with six victories (three B-24s and three P-38s). His awards included the Bravery Cross and the Iron Cross, and he retired after the war as a major general.

as the two previous strikes. The Bulgarian fighters – 17 Bf 109s of 3/6 Orlyak and, for the first time, 24 D.520s of 2/6 Orlyak (six took off from Vrazhdebna and 18 from Karlovo) – were scrambled too late to mount co-ordinated defensive efforts. The enemy fighter escort of about 60 P-38s, heavier than the previous strike, was neutralised successfully, thus enabling seven Bf 109Gs to reach the bombers and to prevent their precise bomb drops. No confirmed kills were reported this day. One D.520 and its pilot were lost. It is worth mentioning that although the raiders suffered no losses, the 10 December air defence action was highly effective in that the bombing of Sofia caused only 30 casualties, and fewer than 100 buildings were destroyed.

Suicide ramming

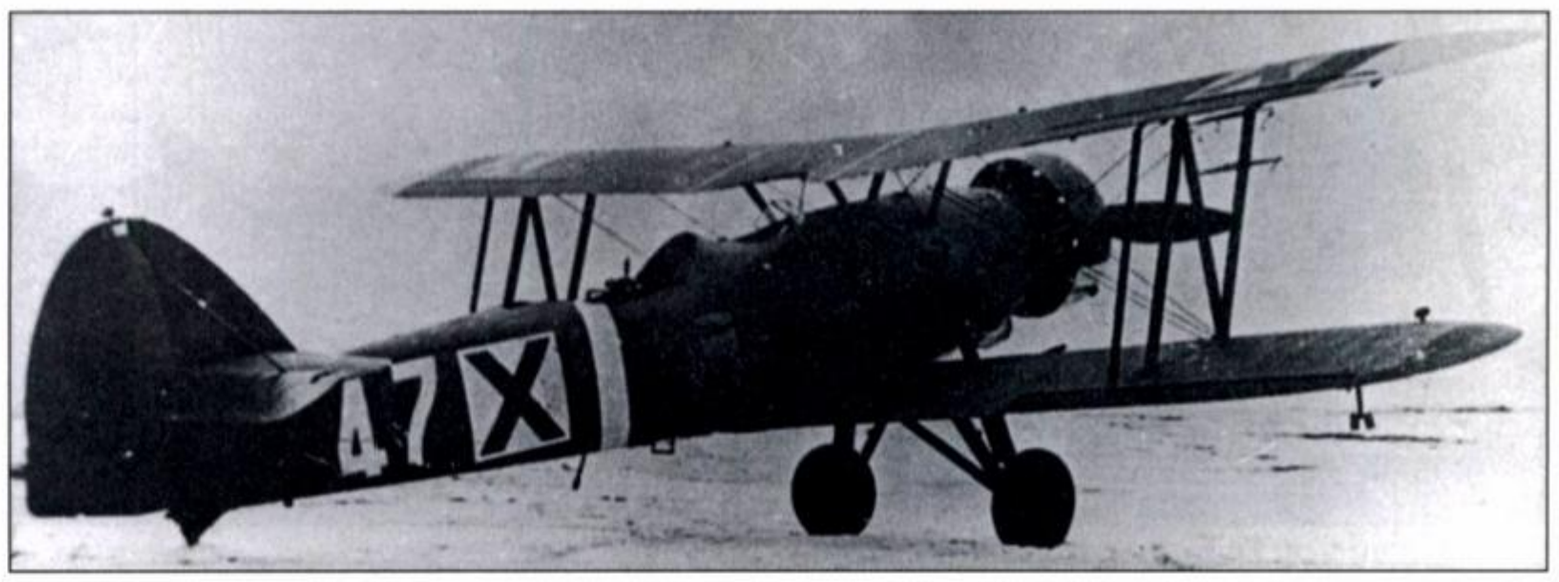
The fiercest air combat during the 1943 raids on Sofia occurred on 20 December 1943. Three formations of a total of 50 B-24s flying at 22,000 ft (6705 m), escorted by a similar number of P-38s, approached Sofia on their usual route to the Balkans – via Valona and Scodra in Albania, Veles in Macedonia, Gorna Oriahovica and Dupnica in Bulgaria. By 12.30 the first of the 16 Bf 109Gs of 3/6 Orlyak had taken off from Bojourishte, simultaneously with the lead element of the Vrazhdebna-based 24 D.520s of 2/6 Orlyak. For the first time, the two fighter orlyaks were ordered to fight co-operatively. 2/6 Orlyak started the first firing run against the lead enemy group approaching from the south at 21,000 ft (6400 m). Ignoring the escort, the D.520s mounted deliberate head-on firing passes, followed by the Bf 109Gs. The 'Gustavs' were able to perform an upward-downward pass through the formation and then merged with the escorting P-38s. Two Lightnings were rapidly shot down by the agile D.520s. Most of the bombers of the southern group hastily dropped their ordnance when engaged, before reaching Sofia. A small group, which at last approached the southern outskirts of the capital, was attacked by a brave pilot from 3/6 Orlyak, Poruchik (Lieutenant) Dimitar Spissarevsky. Flying a Bf 109G-2, he made a deliberate firing pass on one bomber and then undertook an intentional suicide ramming on another B-24 in the same formation.

The second bomber group which approached from the north faced heavy AAA fire, which prevented precise drops. The Bulgarian pilots achieved 10 confirmed kills (seven P-38s and three B-24s) and, according to the official VNVV records, damaged at least five more enemy aircraft (one P-38 and four B-24s). Their own losses numbered two pilots and two Bf 109G-2s. Several more Bf 109Gs and D.520s were heavily damaged by enemy fire and made belly landings. The 20 December air battle was the most efficient air defence operation by the Bulgarian fighter force, as 10 per cent of the enemy aircraft participating in the raid were confirmed shot down.

On 10 January Sofia was again the main target for the Allies. This was the most devastating air raid, followed for the first time by another one in the night, carried out by 44 RAF Wellingtons. For the first time, a Luftwaffe Jagdgeschwader of 25-30 Bf 109Gs was involved in the air defence of the capital in addition to the main force of 70 airworthy VNVV Bf 109Gs and D.520s of 2/6 and 3/6 Orlyaks. The former unit had just began its conversion to the Bf 109G-6, 28 of which were donated by the Luftwaffe in early January. Another VNVV fighter unit – the D.520-equipped 1/6 Orlyak at Karlovo – was incorporated in the air defence of the capital for the first time. They were tasked to resist the heaviest Allied strike to date, which caused considerable devastation to the city centre. The strike package of about 150 B-17s, escorted by about 100 P-38s, approached Sofia from the east at 21,000 ft (6400 m). The three yata of 3/6 Orlyak, with a total of 16 Bf 109Gs, faced the enemy first, mounting a steep dive attack on the lead bomber group after penetrating the escort. The following 20-minute air combat with the P-38s left the bombers without fighter escort, thus allowing 32 D.520s to attack them just over Sofia. Their head-on firing passes scattered the first B-17 group but the next ones were able to carry out their bomb drops without fighter resistance, causing severe devastation to the densely-populated centre of Sofia. The official VNVV combat reports stated six B-17 and five P-38 kills for losses of two D.520s and one pilot. The Luftwaffe unit which was also employed in this battle suffered heavy losses. Five pilots were lost with their aircraft and a similar number successfully took to their parachutes, including the CO.

Day and night raids

The second night large-scale bombing raid against Sofia was organised on 29 March. About 50 British Mosquito bombers mounted a very destructive raid, followed by one the next morning by 367 B-17 and B-24 bombers in several waves, escorted by 150 P-38 fighters. All serviceable Bulgarian fighters were called upon: 20 Bf 109G-2/6s of 3/6 Orlyak followed by 19 Bf 109G-6s and six D.520s of 2/6 Orlyak, and then by 28 D.520s of 1/6 Orlyak and four D.520s of 4/6 Orlyak, and at last four B 135s of Sofia by the 15th Air Force. A total of 91 B-25s and 49 P-38s took part in the raid.



One of the most popular VNVV front-line aircraft of the early 1940s was the Letov Smolik S 328. Sixty units were delivered second-hand in 1939.

The 15 Bf 109Gs of the capital's air defence suffered from scrambling late, and achieved only one confirmed kill. One Bf 109 and its pilot were lost.

24 November Second air raid on Sofia by 60 B-24s and 40 P-38s. Twenty-one Bf 109Gs scrambled. Two confirmed B-24 kills against the loss of one Bf 109 and its pilot.

10 December Third air raid on Sofia by 50-60 B-24s and 60 P-38s. Seventeen Bf 109Gs and 24 D.520s were scrambled. No confirmed kills, Bulgarian losses were one D.520 and its pilot.

20 December Fourth air raid on Sofia by 50 B-24s and 50 P-38s. Sixteen Bf 109Gs and 24 D.520s scrambled. Three B-24 and seven P-38 confirmed kills. Bulgarian losses were two Bf 109Gs and their pilots. Bulgarian pilot Poruchik Spissarevsky downed a B-24 by intentional suicide ramming.

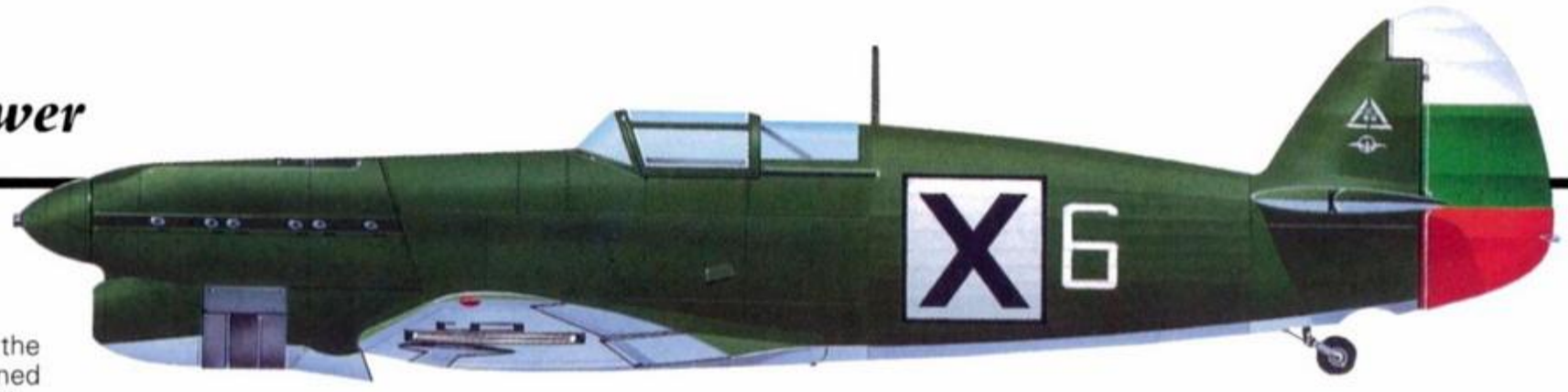
Late 1943 Eighteen Fw 189A-2 delivered to the 3rd Orlyak of the 1st RP at Yambol.

1944

January Delivery of 13 ex-Luftwaffe Ju 87D-5 'Stuka' bombers to 1/2 Orlyak.

2 January Reich donated 28 Bf 109G-6s.

4 January First Allied air raid on Sofia in 1944. Due to thick fog over the city other targets in Bulgaria were bombed.



Avia B 135

The 12 B 135s of the VNVV were the only examples of this fighter to enter service, with the VNVV's Fighter School. The tail triangle contained the inventory code, in this case aircraft code '6' above type code '5057'.

Twelve Junkers Ju 87R-2 Stuka bombers entered service in December 1943. They were used mainly for pilot conversion and continuation training rather than in the front-line role.

the Fighter School. The first wave was engaged 30 km (18 miles) from Sofia. Penetrating the strong fighter escort, the leader of the first attacking yato knocked out a B-17, and the young pilot Kostakiev was able to score a rapid double kill – the first B-17 he fired at exploded in the air while still in formation, and some large debris fatally hit one of the neighbouring aircraft. Despite the losses, the first wave of about 120 bombers penetrated the fighter cover of 3/6 Orlyak and delivered its ordnance on Sofia, where the Bf 109G-6s of 2/6 Orlyak attacked. 1/6 Orlyak faced a bomber group approaching from the north. The first wave was followed by two more which also fell under the fierce attacks of the Bulgarian fighters. The fourth wave of about 70 B-24s approached at the moment when all the VNVV fighters were occupied. The only Bulgarian fighters which were able to engage in effective contact with this new enemy were four B 135s. These lightly-armed training fighters, with only two 7.92-mm machine-guns, were flown by the instructors of the Fighter School who made an unauthorised take-off to strengthen the air defence of the capital. The B 135s made several firing passes on a B-24 group and the lead pair eventually damaged two of the engines of a lone Liberator, reported as a probable kill.

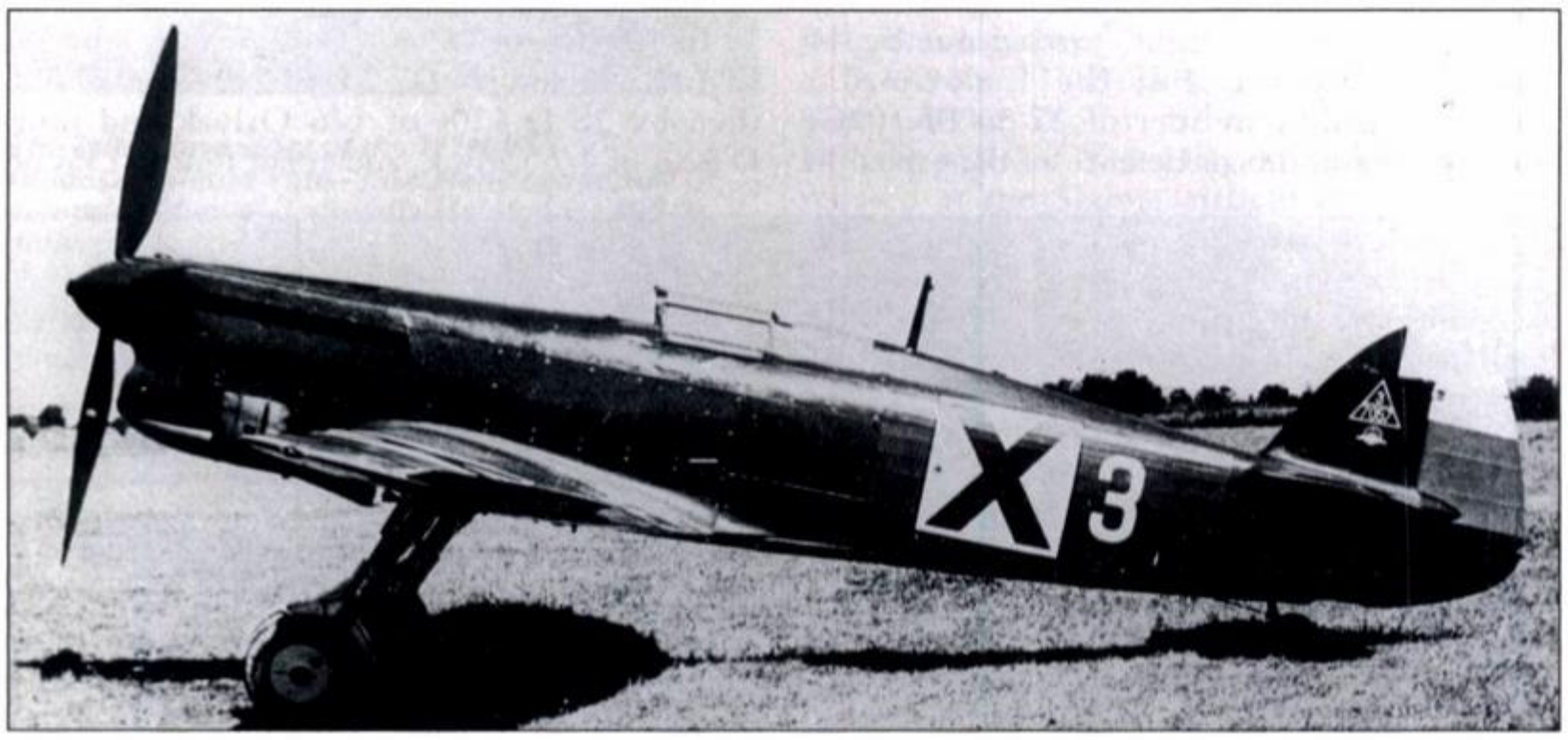
The 30 March air combats resulted in four B-24s and three P-38s confirmed destroyed. Bulgarian losses numbered two Bf 109Gs and one pilot from 3/6 Orlyak, as well as four D.520s and two pilots from 1/6 Orlyak.

Combat attrition

The 10th and final raid against Sofia, by about 350 B-17s escorted by more than 100 P-51 and P-47 fighters, took place on 17 April and annihilated vast areas around the central railway station and the Iliantzi railway terminal. The dwindling number of defenders suffered the heaviest losses of the war – almost half of the fighters launched by 2/6 Orlyak were either shot down or heavily damaged.

The heavy attrition from the previous combats had left 3/6 Orlyak with only 14 combat-ready aircraft out of 36, while 2/6 Orlyak had 16 Bf 109G-6s and two D.520s. 1/2 Orlyak contributed five more D.520s which, however, were not able to find the enemy. The lack of any modern tactical knowledge by the VNVV high command was the main factor preventing rational use of the available fighters, thus contributing to the heavy losses. As ever, 3/6 Orlyak was the first to engage the lead element of the B-17 formation. For the first time, the Allied fighter escort included large numbers of P-51 Mustangs and P-47 Thunderbolts. The Bulgarian fighter pilots, used to facing only the twin-engined P-38, initially assumed that the enemy single-engined fighters were either reinforcements from 1/6 or 4/6 Orlyaks or from Luftwaffe units based in Bulgaria. The P-51s' surprise firing passes at the misguided Bulgarians proved deadly effective – nine fighters were shot down, six pilots were killed, three fighters made belly landings, and all the surviving fighters were extensively damaged. US losses numbered one B-17 shot down, six more heavily damaged and others lost on the way back, plus at least one damaged P-51. The 12 AAA batteries deployed around Sofia fired 3,062 rounds and damaged three bombers. Bulgarian pilot Poruchik Bonchev made the second ramming of a US bomber during the air defence of Sofia: during his firing pass Bonchev was not able to pull out in time and hit the tail of his target bomber. He was thrown from the cockpit by the subsequent explosion and successfully took to his parachute. (On 10 November 1944 Bonchev was shot down during a strafing attack on a Wehrmacht truck convoy in Macedonia; he took to his parachute again, only to be taken POW after the landing. Weeks later, Bonchev was killed by the Nazis.)

The air raids against Sofia ended with the 17



The Avia B 135 was a fighter type unique to the Bulgarian air arm. Twelve aircraft were delivered in kit form in early 1943 and assembled by the local DSF factory. They were used as continuation trainers by the instructors of the Dolna Metropolya-based Fighter School, but saw combat against B-24s on one occasion.

10 January First combined day-night air raid on Sofia. Some 180 B-24/17s and 100 P-38s were involved in the day raid; 39 VNVV fighters scrambled – 16 Bf 109Gs and 23 D.520s. Six B-17 and three P-38 kills, for loss of two D.520s and one pilot. Night raid was mounted by 70-80 RAF Wellingtons. AAA rendered ineffective.

24 January Third Allied air raid on Sofia. Due to thick fog other targets in Bulgaria were bombed.

16 March First night air raid on Sofia in 1944 by 50 RAF bombers. No fighters scrambled due to lack of night training and equipment. AAA was ineffective.

24 March Second night raid on Sofia. AAA ineffective.

30 March Second combined night-day air raid on Sofia. The night element was carried out by 40-50 RAF bombers. AAA was ineffective. Day element was carried out by 367 B-24/17s and 150 P-38s; 77 VNVV fighters scrambled – 39 Bf 109Gs, 34 D.520s and four B 135s. Four B-24 and three P-38 confirmed kills, for losses of two Bf 109Gs, four D.520s and three pilots.

17 April Third and last combined day-night air raid on Sofia. Day element carried out by 300 B-17/24s, and about 100 P-38s and P-51s; 37 VNVV fighters scrambled – 30 Bf 109Gs and seven D.520s. Two B-24 and two fighter kills confirmed. One bomber downed by ramming. Bulgarian losses were nine fighters and six pilots.

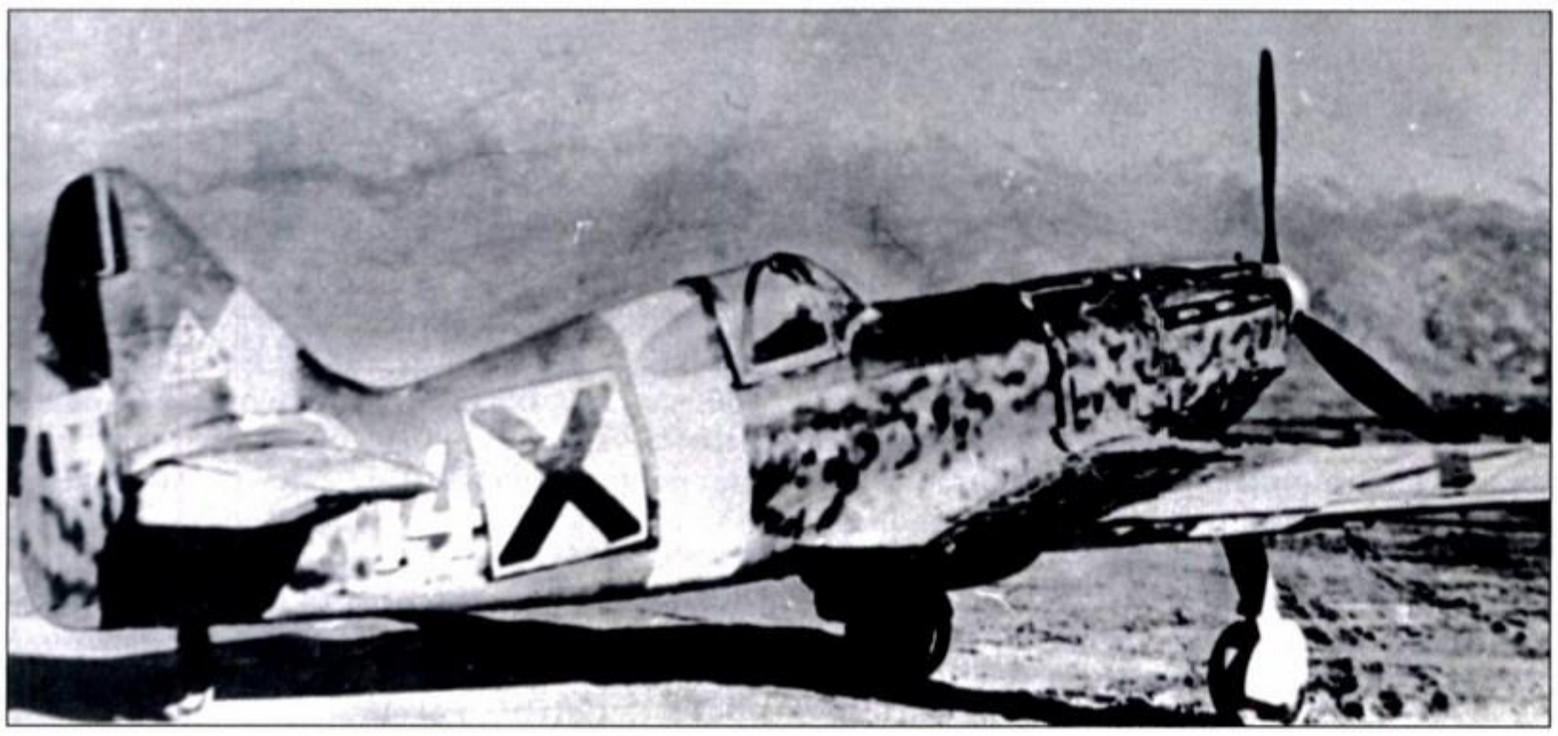
May Delivery of 19 Ju 87D-5s to 1/2 Orlyak.

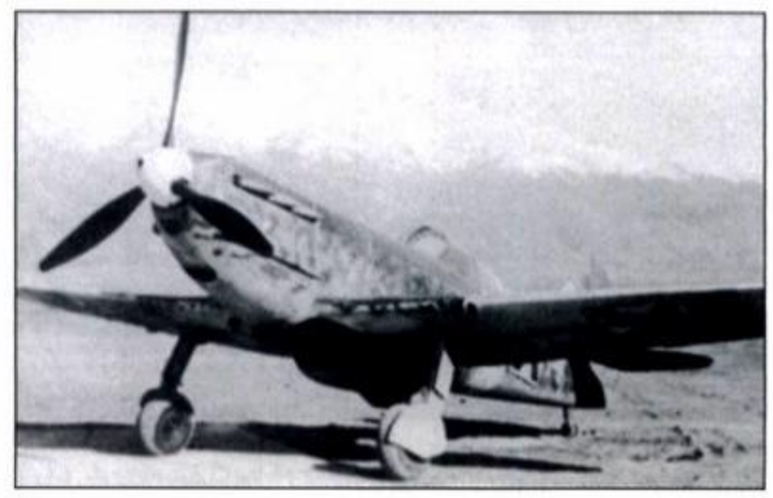
12 June First air raid on the VNVV main fighter base at Karlovo carried out in the night by about 50 RAF bombers. Eighteen VNVV fighters and trainers destroyed.

28 June Second air raid on Karlovo

Dewoitine D.520

Wearing a mottled Luftwaffe-type colour scheme, this Dewoitine D.520 was on the strength of the 3rd Yato, 6th Fighter Orlyak at Bojourishte in February 1944.





Often dismissed as obsolete, the D.520 in late 1943 and early 1944 was a relatively potent air defence fighter. The D.520 pilots defending Sofia claimed 14 confirmed kills. In mid-1945 the survivors were transferred to the Fighter School, and served until late 1946.

April action but later in the spring and the summer other towns were bombed, followed by Karlovo airfield, a major VNVV base. The first strike against the base took place in the night of 12 June when 20 RAF bombers destroyed 18 aircraft on the ground and killed 20 airmen. The next strike – in daylight on 28 June – was carried out by 150 B-17s which pounded both the air base and the nearby ordnance factory at Sopot. Over the former target the B-17s faced the resistance of a small number of 20-mm guns and were able to devastate the air base, destroying 70 aircraft and killing 25 airmen. Only two of the aircraft destroyed were Bf 109s. During the same raid a pair of the escorting P-51s independently attacked Graph Ignatievo airfield, located 30 km (18 miles) from the main target. The pair made a strafing pass against the lined-up Ju 87D-5s of the 2nd 'Stuka' Polk, damaging seven of them. One of the bombers was shot down by the 75-mm AAA battery defending the Sopot-based ordnance factory. No Bulgarian fighters were scrambled to defend Karlovo on this day.

Combat record

The Allied bombing raids carried out between April 1941 and September 1944 resulted in 1,828 dead and 2,372 wounded Bulgarian citizens. Some 50,000 high-explosive and incendiary bombs had been dropped on Bulgarian territory. The Bulgarian fighters continued their actions against Allied bombers overflying Bulgaria on their way to and from Ploesti in the summer of 1944. The most successful summer air combat occurred on 17 August when 3/6 Orlyak scored one probable and four confirmed B-17 kills.

Thus, the final combat record of the Bulgarian fighter force between 1 August 1943 and 9 September 1944 reached 53 confirmed kills, among them 37 four-engined bombers as well as 16 P-38 and P-51 fighters. Four four-engined bombers were claimed by the AAA. The damaged aircraft and probable kills numbered 70 – 48 bombers and 22 fighters, some of which crashed or force-landed on their return route over Serbia, Albania and the Adriatic Sea. Some 117 wrecks of Allied aircraft, shot down during their strikes on Bulgarian and Romanian targets, were located on Bulgarian territory. The Bf 109Gs and the D.520s of the 6th Fighter Polk accumulated about 970 combat sorties, 550 flown by the pilots of 3/6 Orlyak, 275 by 2/6 Orlyak, 90 by 1/6 Orlyak and 52 by 4/6 Orlyak. Bulgarian losses numbered 27 fighters and 23 pilots. Several of the pilots killed took successfully to their parachutes but were strafed by the enemy fighters. More than 30 fighters made forced landings due to extensive combat damage.

During the air defence of Sofia the losses of the Allied forces averaged 1.5 per cent. Their average numerical superiority ratio was about 7:1. In some raids, when the ratio was more favourable for the Bulgarian fighters and the orlyaks fought in co-operation, Allied losses could be increased to 10 per cent, a figure achieved by the fighter air defences of Berlin, London, Ploesti and Moscow, which were considered the most powerful of the war. Although severe damage and demoralisation was caused by the Allied bombings, the main objective of the Point Blank operation was not achieved – Bulgaria remained an Axis member until 4 September 1944, providing logistic support to the Wehrmacht. No serious attempts to break away from the Third Reich took place between late 1943 and mid-1944.

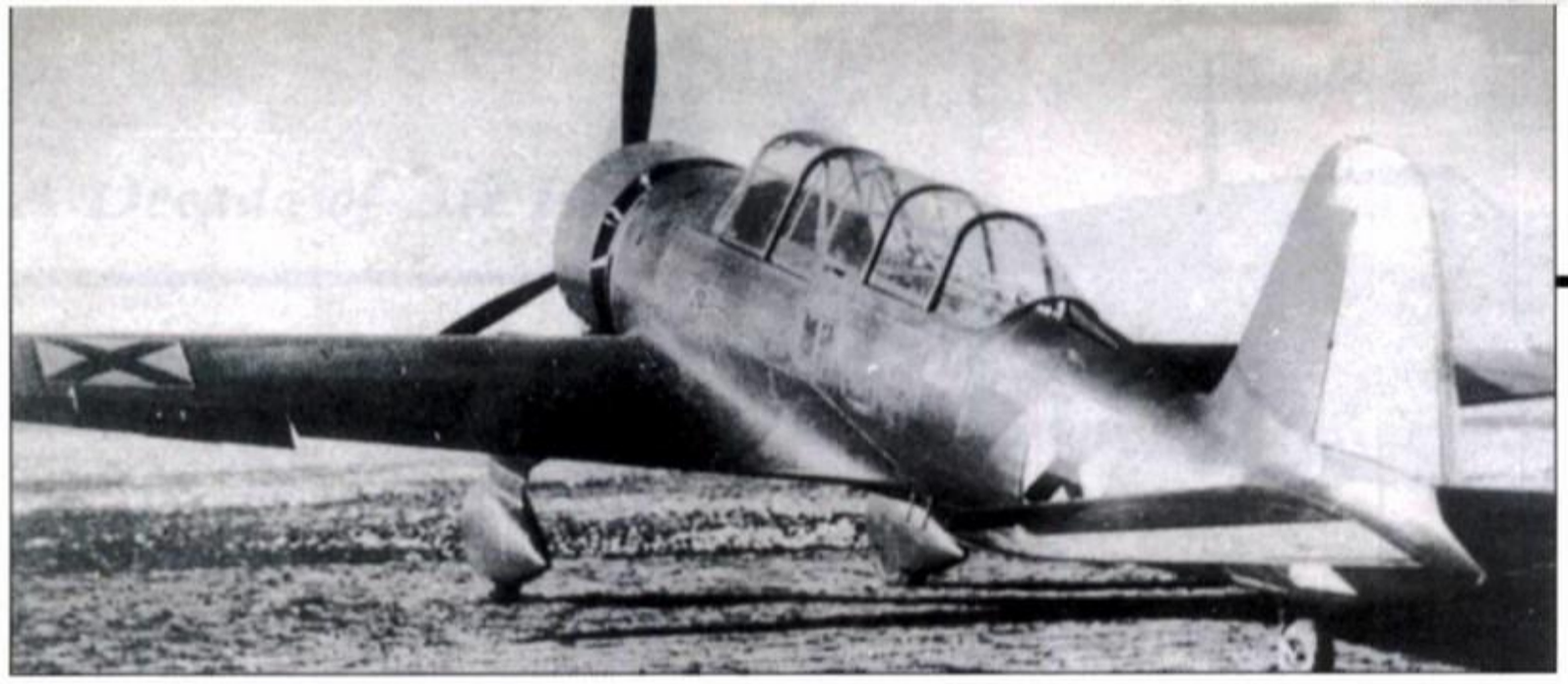
The VNVV ground attack and reconnaissance units saw limited combat in 1943 and in the spring and the summer of 1944. There were occasional actions against the Communist insurgency based in the mountainous regions of central and southern Bulgaria and eastern Serbia, typified by the reconnaissance missions flown by the S 328s and the KB-3/4/5s of the 1st Polk. On several occasions the reconnaissance aircraft were used in anger to provide support to ground forces by strafing and bombing. The Stukas of 2 Polk were also employed on some missions in the summer of 1944, losing one aircraft.

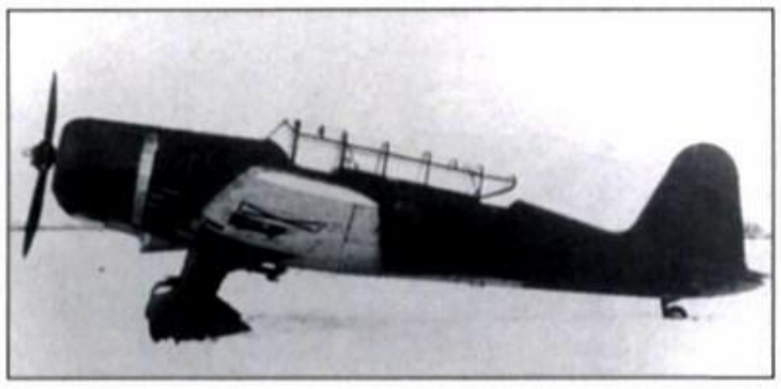
Southern deployment

The most active close air support unit was the composite army yato of the 1st Polk, which was assigned to the 1st Occupation Corps in Serbia and Macedonia. The unit saw much action supporting the ground troops during the battles against the Serbian Communist insurgency in 1944. The unit – with six S 328s, three B 534s and one Fi 156 – was based at Nish airfield in eastern Serbia. Both types flew a large number of combat missions against the Tito-led guerrillas, during one of which a B 534 was shot down near the Bulgarian border. The rest of the inventory was destroyed on 17 August by a 15th Air Force bombing raid on the airfield, carried out by 12 P-38s.

In anticipation of a large-scale Allied landing on the Aegean coast by the end of August, all VNVV front-line units were deployed to the southern regions of Bulgaria. By that time, most

Ninety-six used Dewoitine D.520 fighters, originally destined for the air defence of the Third Reich, were taken on strength with the VNVV in September and October 1943. They eventually served with three orlyaks.





The DAR-10A reconnaissance and close air support prototype aircraft was a modern front-line type of early 1940s. Despite its advantages, the aircraft was not launched in production, losing to the rival KB-11.

of the ground attack and reconnaissance units were manned by well-trained aircrews, some of whom had operational experience gained during their deployments to Greece and Yugoslavia, while others had undergone training in Germany in 1943 and 1944. By late August the Wehrmacht units stationed in Bulgaria began their withdrawal toward Greece and Serbia, and on the way attempted to seize the fuel stored at several VNVV bases. The local VNVV commanders, however, took action, arresting German railway and truck convoys transporting fuel and ammunition to Greece. There, the Luftwaffe fleet of 60 fighter, 20 reconnaissance and 109 transport aircraft suffered a permanent fuel shortage.

A new war

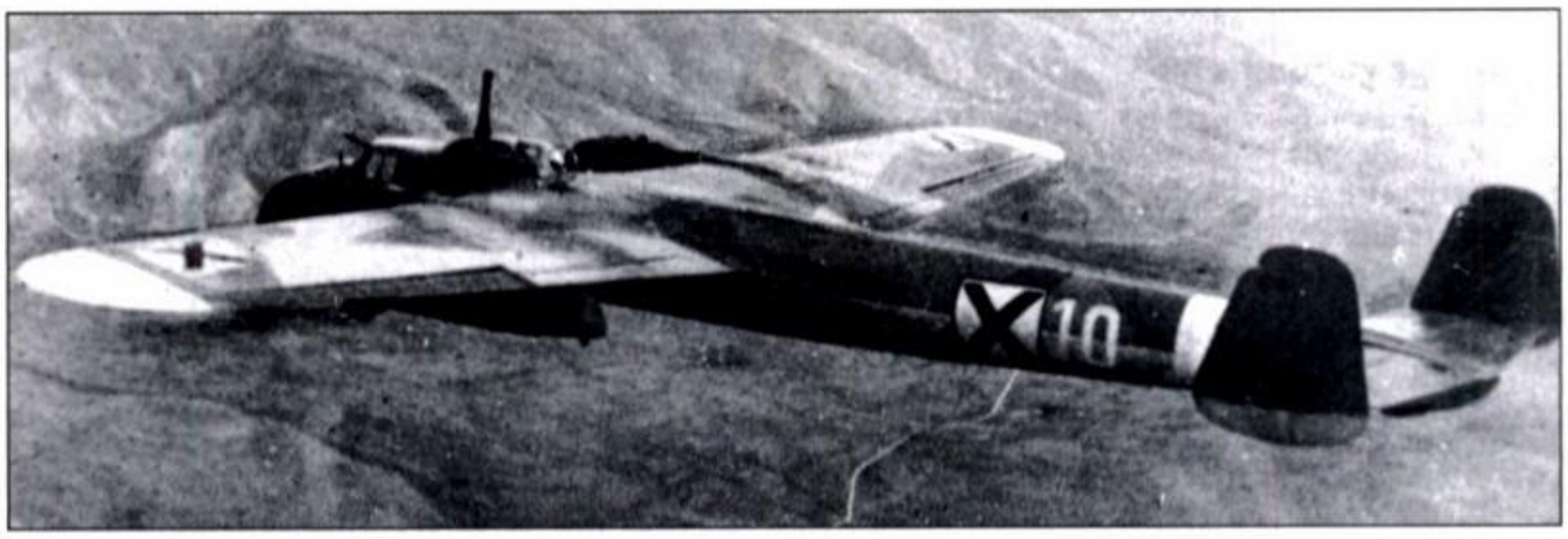
The rapid advance of the Red Army toward the Bulgarian borders in late August and early September 1944 caused considerable political changes in Bulgaria. On 4 September a new government was formed by the legal opposition. It declared Bulgaria's break with the Axis and immediately commenced secret talks with Britain to set up a separate peace agreement. However, this government was short-lived as the rapidly deteriorating situation in Bulgaria led to more radical changes. On 5 September the Soviet Union declared war on Bulgaria and the first Red Army units crossed the Bulgaria-Romania border three days later. In the early morning of 9 September the Communist- and Social Democrat-led opposition union – the Otechestven Front (OF – Patriotic Front) – staged a successful coup, during which the majority of the Bulgarian Army stayed neutral, while the Sofia-based armour and AAA units supported it. The newly-formed OF government declared war on Germany that same morning and the Bulgarian armed forces were ordered to prepare a large-scale offensive against the Wehrmacht armies in southern Serbia and Macedonia. The rapidly-advancing Red Army took control of the northern part of the country in anticipation of an offensive operation against the Serbian capital of Belgrade.

The VNVV was ordered to provide close air support for the three Bulgarian armies. The front-line units earmarked to participate in the 'new' war were the Vazdushna Escadra (controlling three polks), the 1st RP and 73rd Yato za Dalechno Rasusnavane (YDR – long-range reconnaissance squadron). The strike assets were grouped within the 2nd 'Stuka' Polk, which controlled two orlyaks – 1/2 equipped with 29 Ju 87D-5s, and 2/2 with 19 B 534s. The 5th Bombandirovachen Polk also consisted of two orlyaks – 1/5 equipped with 20 Do 17M/P/Ka-1s, and 2/5 with 21 B 71s. The 6th Iztrebitelen Polk, which suffered heavy combat and non-combat attrition from late 1943 to mid-1944, commenced the 'new war' with four combat-ready orlyaks – 1/6 equipped with about 30 D.520s, 2/6 with 52 Bf 109G-2/6s, 3/6 with 49 Bf 109G-2/4/6s, and 4/6 with about 30 D.520s. The 1st RP controlled two orlyaks – 3/1 equipped with 14 Fw 189A-2s, and 4/1 with 15 S 328s and 14 KB-11s. The 73rd YDR had five Do 17Ps on strength but only one was combat-ready at any time. The sole air transport unit – the Prenosno Yato (air transport squadron) – had an inventory of four Ju 53/3ms. More than half of the VNVV front-line aircraft were unserviceable by the start of the battles and only a small proportion of the inventory was made up of modern types. The aircrews who participated in the war numbered 279, of which 160 were pilots, 73 navigator/observers and 46 gunner/radio operators.

First battles

The first combat actions of the VNVV in the anti-Nazi war had taken place by mid-day on 9 September, on which a total of 35 combat sorties was flown. The escadra was ordered to mount a pre-emptive air strike against the Luftwaffe airfield at Nish and to provide close air support to the 15th Infantry Division of the 1st Bulgarian Occupation Corps in Macedonia, which was encircled by Wehrmacht troops near the city of Biloya. The Nish strike, carried out by three Bf 109Gs of 3/6 Orlyak, resulted in six Luftwaffe fighters destroyed on the ground. Bulgarian losses numbered one aircraft and its pilot. Six Do 17s of 1/5 Orlyak, transferred earlier that morning from Tchirpan to Bojourishte, and nine Ju 87D-5s of 1/2 Orlyak mounted effective strikes to help the 15th Division penetrate the surrounding Wehrmacht troops and to initiate its retreat towards the Bulgarian border. One Do 17 was damaged by AAA fire over the target and made a forced landing on Bulgarian territory. The pilot of one of the Ju 87D-5s, who was unwilling to fight the Germans, escaped the battle and landed his aircraft on a Luftwaffe airfield in Macedonia.

Subsequent strikes were carefully planned in co-operation with the Soviet 17th Air Army, which was based in the northern part of the



A Bf 109G-6 of 3/6 Orlyak seen after a successful life-saving belly landing due to battle damage inflicted by the guns of 15th Air Force P-38s.

Right: The main wartime-era bomber of the Bulgarian air arm was the Dornier Do 17. Eighteen ex-Luftwaffe Do 17Ps entered service with the 5th Bomber Polk in September 1940.

airfield by 150 B-24 bombers and 50 P-51s. Seventy VNVV combat and training aircraft destroyed on the ground including two Bf 109Gs. One B-24 shot down by AAA over the city of Sopot.

17 August Allied air raid on Nish airfield destroyed all aircraft on strength of the composite yato of the 1st Occupation Corps, including six S 328s, three B 534s and one Fi 156.

26 August Last air combat carried out against 15th Air Force bombers. Sixteen Bf 109Gs involved. One bomber and one fighter claimed, no Bulgarian losses.

4 September New government formed by the legal opposition parties which declared a breakaway from the Axis and immediately commenced secretive talks with British officials in Cairo upon signing a separate peace agreement.

5 September The Soviet Union declared war on Bulgaria.

8 September The first Red Army units crossed the Bulgaria-Romania border.

9 September A Communist- and Social Democrat-led coup took place. A new government formed by the Patriotic Front coalition took power immediately, declaring war on the Third Reich. The VNVV was ordered immediately to mount strikes on Wehrmacht positions in Macedonia and Serbia. Some 35 combat sorties flown, two aircraft and three crew members being lost.

First air combat between six Luftwaffe Bf 109Gs and six VNVV B 534s. One Bulgarian aircraft shot down.

11 September Bulgarian Supreme Command ordered the Air Escadra to

Aircrew of a Vrazhdebna-based Do 17M have a pre-mission brief during the days of the hottest fighting at the Strazhin position in Macedonia in October 1944.

A Stuka formation flies towards its targets in Macedonia in November 1944. The Stuka Orlyaks were supporting the break-out of the Bulgarian occupying forces from German encirclement.

country and around Sofia in mid-September. The demanding mountainous terrain and the rapidly deteriorating weather in the southern Balkans in the autumn were familiar to the Bulgarian aircrews, so they were considered better suited to operate in this region at low level than the Soviets. The VNVV was tasked to provide close air support to the Bulgarian Army divisions advancing in the mountainous region of southern Serbia and Macedonia. The 17th Air Army was restricted to operations in central and northern Serbia and then in Montenegro. In order to prevent incidents and losses from friendly fire – for the majority of Bulgarian aircraft were German-made – the two air arms operated concurrently in non-overlapping zones. Within the few common operating zones they were ordered to operate at different times. In addition, Bulgarian front-line aircraft received new identification markings of white-painted wingtips and bands around the rear fuselage. It must be noted that the Bulgarian-made KB-11 was only briefly used in combat due to its similar appearance to the Luftwaffe Henschel Hs 126, a few of which occasionally flew strike missions on the Bulgarian forward positions. There were several occasions when the Bulgarian troops fired at the KB-11s when they crossed the front line. In order to prevent losses from friendly fire, the type was promptly withdrawn from combat use.

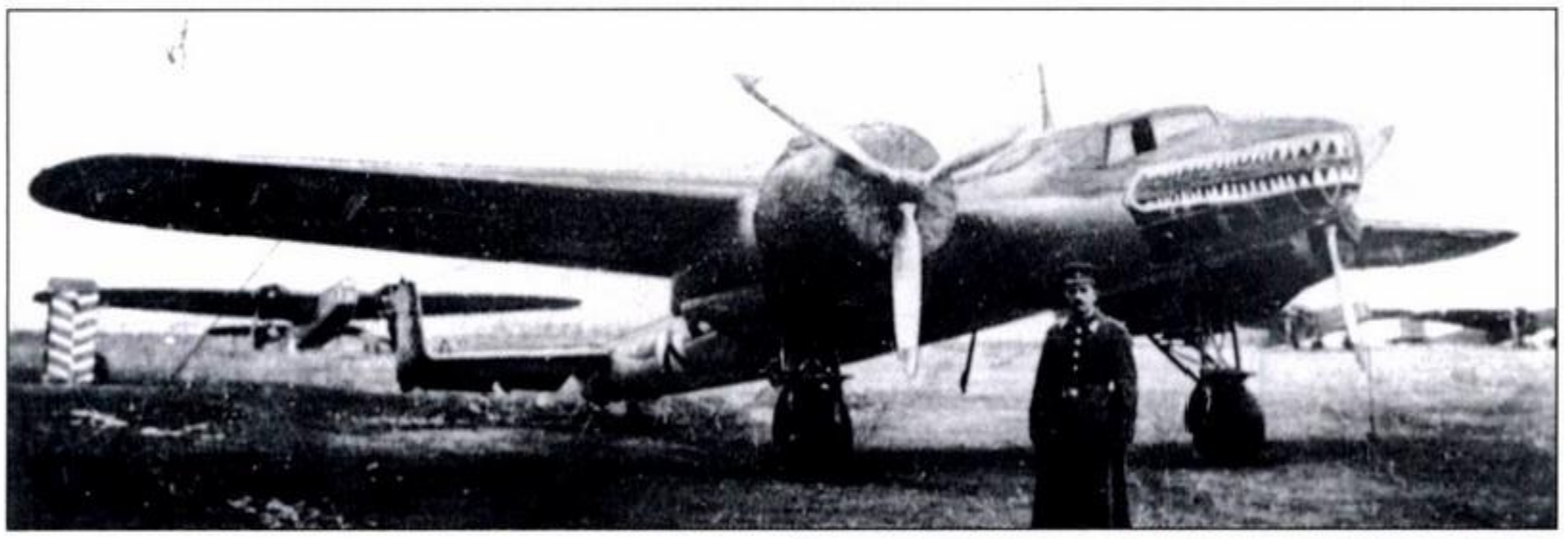
Four Bulgarian land armies were tasked with the offensive in southern Serbia and Macedonia in order to cut off the main routes of retreat north for the Greece-based Wehrmacht Army Group 'E'. The retreat towards Croatia and Hungary through Macedonia and Serbia was covered by reinforced units, positioned along the Bulgarian borders.

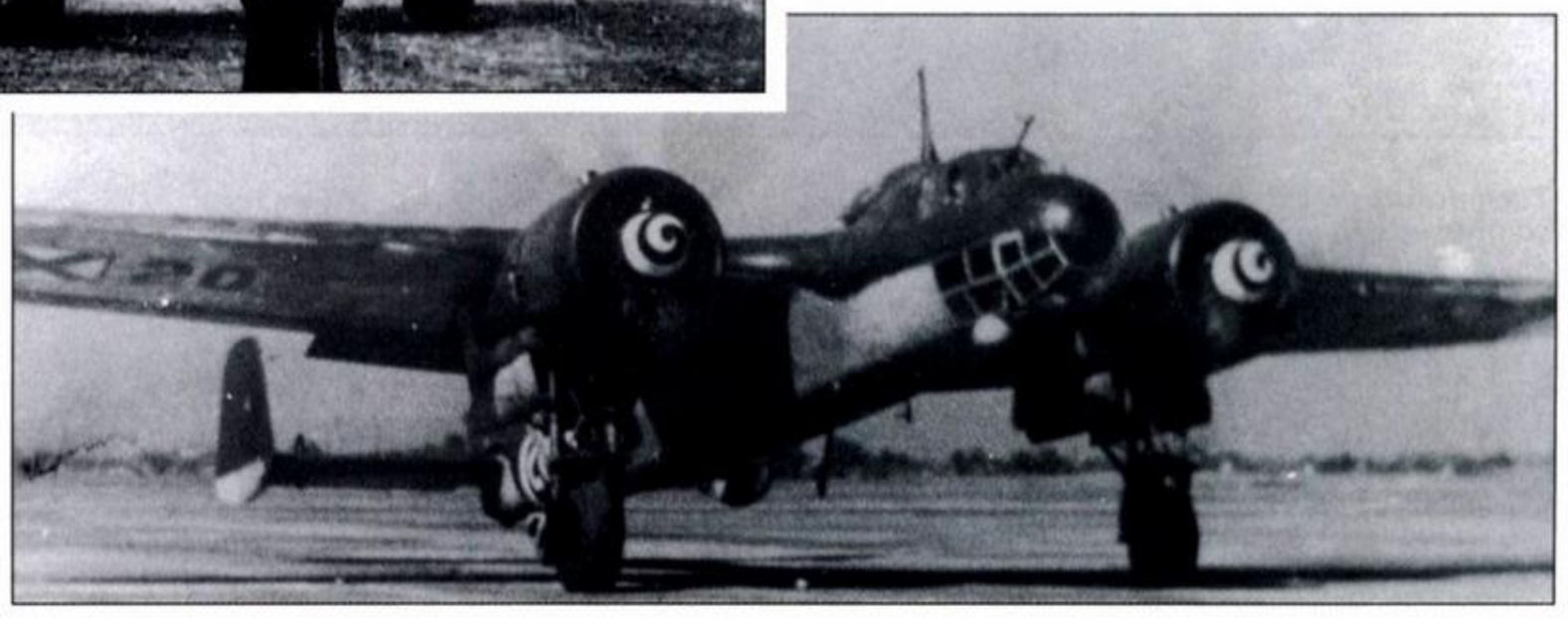
Air superiority

The 17th Air Army was able to achieve absolute air superiority in the Balkans, thus providing the VNVV with the chance to operate in the virtual absence of enemy fighters. A limited number of Hs 126 and Ju 88 reconnaissance aircraft, as well as a few Fi 156 Storch liaison aircraft, were the only active Luftwaffe assets in the theatre. On occasion, small fighter groups made raids deep into Bulgarian territory during the first days of the war, the best-known being the 9 September attack on a fuel storage facility in central Bulgaria, carried out by six Bf 109s. Six VNVV B 534s were caught on the same raid during their ferry flight from Plovdiv to Bojourishte. The encounter led to the loss of one B 534.

Air cover for Sofia against Luftwaffe raids was provided by the four orlyaks of the 6th Polk in co-operation with the Vrazhdebna-based Soviet 288th Iztrebitelna Aviodivizia.

The main VNVV actions during the first days of the new war, called the Patriotic War, were as close air support for the retreating 15th Infantry Division and strikes against small Wehrmacht ground units advancing near the border. The long- and close-range reconnaissance units began regular missions over the road and railway network, discovering





Above: In October 1941 the 5th Polk took on strength 15 ex-Yugoslavian Do 17Ka-1s taken as war trophies by the Bulgarian Army in Macedonia. Due to lack of spare parts and engines, only six were restored to flyable condition. A Do 11 can be seen behind this shark-mouthed example.

Right: A Do 17M bomber of the second batch of ex-Luftwaffe aircraft taxis out. These aircraft were delivered in September 1943. The Do 17Ms served in the bomber (bombardirovachen) and reconnaissance (rasuznavatelen) roles until replaced by Pe-2s in 1946.

mount strikes against enemy road and railway communications and to provide air support for the advancing ground forces.

8 October Start of the offensive by the 1st and 4th Armies in Serbia and Macedonia.

December The first wave of changes of the structure of the air arm were initiated by a group of Soviet-trained Bulgarian officers, headed by the Hero of the Spanish War Maj. Gen. Zakhary Zakhariev.

2 December The first phase of the Patriotic War ended, thus marking the end of the VNVV active participation in the war. Some 3,744 combat sorties were flown; losses numbered 32 aircraft and 18 crew members.

1945

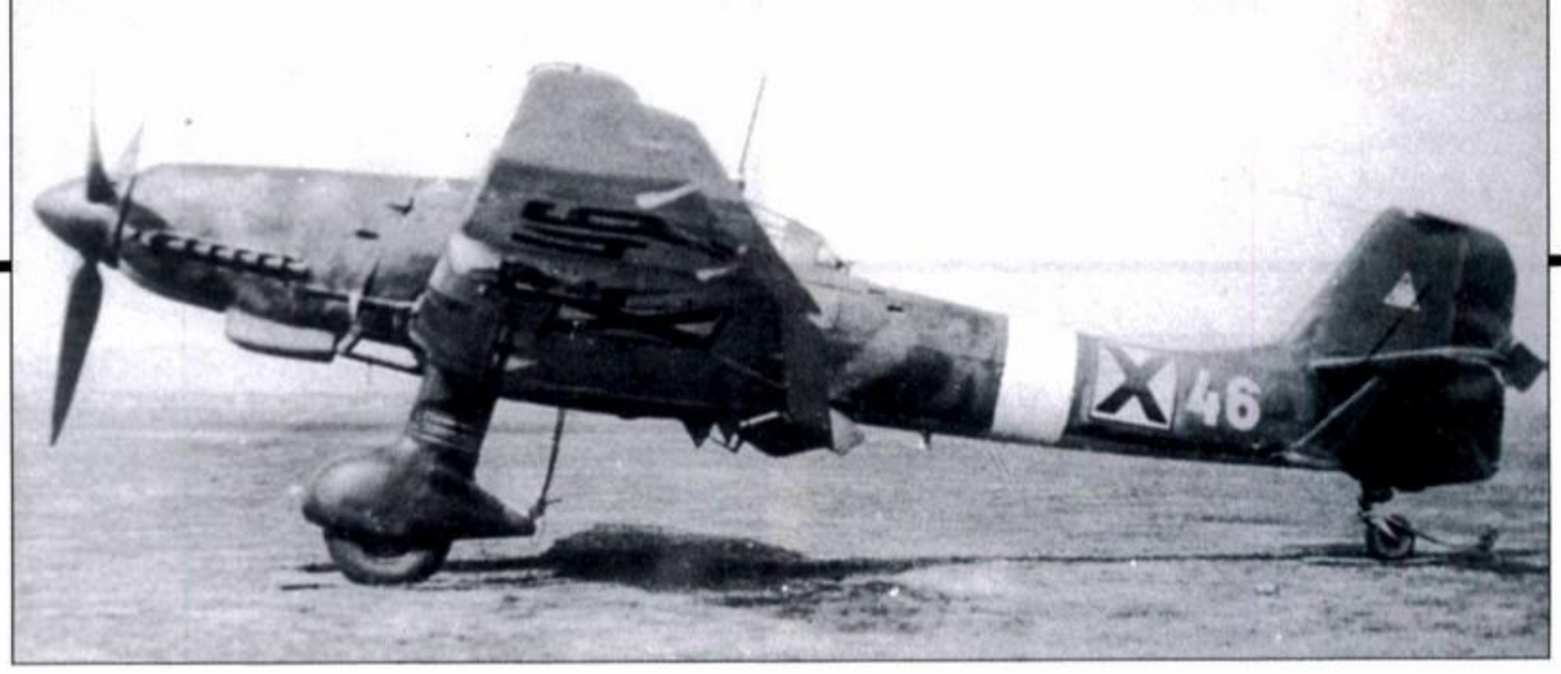
January New (peacetime) structure of air arm introduced. The words 'His Majesty' were deleted from the name of the air arm.

A composite liaison yato of three Fi 156s, one Me 108 and one Do 17 was formed to support the 1st Army, operating in Hungary. Up to May 1945 it flew 680 sorties.

March First flight of DAR-10F close support aircraft. The programme was cancelled after several test flights.

16 March An agreement for delivery of 120 Yak-9 fighters, 120 Il-2 attack aircraft and 98 Pe-2 bomber/reconnaissance aircraft was signed between the Bulgarian and Soviet governments.

31 March 624th Yato of 3/6 Orlyak was

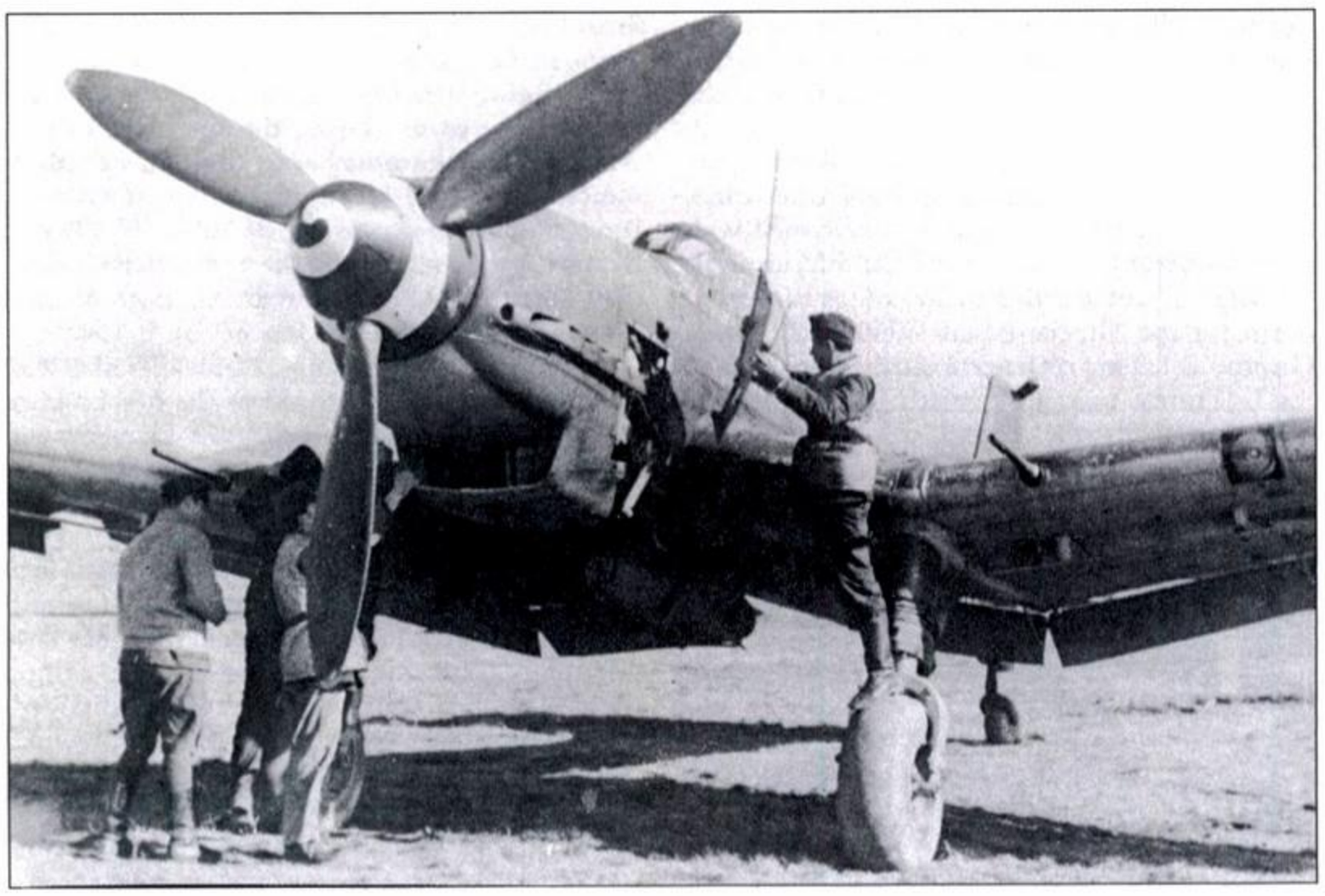


The Ju 87D-5 served with the three front-line yata of 1/2 Orlyak. The first Ju 87D-5 batch of ex-Luftwaffe aircraft was delivered in January 1944.

extensive traffic northward that was heavily defended by AAA. The truck convoys were attacked by the VNVV for the first time on 10 September. During the initial period of the Patriotic War – the preparation of the ground offensive from 9 September to 8 October – the VNVV lost 13 pilots and 11 aircraft, comprising five Bf 109Gs, two D.520s, two Ju 87D-5s and two B 534s lost to AAA fire.

In the early days of the ground offensive daily aircraft availability was between 80 and 100, but this steadily dwindled. The lack of sufficient ground attack aircraft and the virtual absence of Luftwaffe fighters allowed the fighter orlyaks to switch to low-level attack role, where they suffered heavy attrition due to the dense AAA cover. A secondary combat task was the escort of both Stuka and Do 17 strike groups. After the highly effective 12 November attack on Pristina airfield in Kosovo, carried out by 12 Bf 109Gs of 3/6 Orlyak, Captain Atanasov, 3/6's CO, was, for the first – and luckily the last – time, attacked by a group of 15th Air Force P-51 Mustangs. The US pilots erroneously identified the Bulgarian 'Gustav' as a Luftwaffe aircraft but Captain Atansov was able to escape unscathed after evasive action. During the Patriotic War the 6th Polk flew 650 combat sorties, losing nine Bf 109Gs, seven D.520s and a total of seven pilots. Some 120 vehicles, three tanks, 10 artillery trailers, two mobile fuel tanks and 14 aircraft on the ground were destroyed, two small-calibre AAA batteries were effectively suppressed, and two trains plus their locomotives were knocked out.

As could be expected, the most effective Bulgarian ground attack aircraft were the 1/2 Orlyak's Stukas (locally known by the same name, which means pike (the fish) in Bulgarian). They were tasked with routine close air support of the advancing ground troops, in addition to regular strikes on the enemy road and railways in which they hunted for Wehrmacht convoys retreating towards Croatia and Hungary. One of the most prominent Stuka missions was the attack on the Gevgely railway terminal in Macedonia by 20 Ju 87s. Six knocked out a moving train while the rest scored about 15 direct hits on the three trains resting at Gevgely and Sehovo, destroying all locomotives. There were no losses, despite the heavy AAA barrage. Another important mission was carried out on 16 October against a hangar at Skopje airfield, where several Fw 190 fighters were known to be undergoing repair. The successful bombing by the three Stukas caused heavy damage to the hangar and the housed aircraft, thus halting or at least considerably slowing their repair and making their effective use in battle impossible.



Technicians prepare this Stuka for another combat mission against Wehrmacht troops in Macedonia. The majority of the missions were flown against the enemy railway and road communications, where the wing 20-mm guns proved highly effective.

Focke-Wulf vs Stuka

The only air-to-air encounter in the theatre occurred on 3 November when two Stuka groups were attacked by seven Fw 190s immediately before their dive-bombing of a truck convoy. One Ju 87 was lost in the air combat, while the other Stukas were able to escape unscathed at low level or to hide in the clouds. The fire of the Stuka gunners heavily damaged one Fw 190, which was found with a burned-out motor at the captured Skopje airfield several days later.

The other close support unit – 2/2 Orlyak – also actively participated in the battles. On the eve of the war it was equipped with 19 B 534 fighters, re-roled for ground attack, which remained from a total of 78 B 534s delivered in

Right: A Ju 87D-5 of 1/2 Orlyak is seen wearing a Patriotic War white band around the rear fuselage. A total of 29 Stukas took part in the attack operations against the Wehrmacht troops in the autumn of 1944, flying a total of 1,093 combat sorties.

formed immediately and moved to Pech in Hungary to convert to the La-5 fighter, to take part in the closing battles. This never materialised due to the early Reich capitulation on 9 May.

May The first Yak-9Ms, Il-2s and Pe-2s were delivered and conversion courses of Bulgarian aircrews commenced.

The air arm insignia changed to the white-and-red roundel with a green rectangle inset.

9 May Capitulation of the Third Reich.

July One hundred Bf 109G/Ks and many Ar 96 trainers were taken as war trophies in Austria and immediately ferried to Bulgaria.

9 September During the military parade celebrating the first anniversary of the 9 September coup, the VV presented a flypast of three Yak-9Ms – the first public appearance of Soviet-made aircraft in Bulgaria.

12 September The People's Air School for pilot and maintenance officer training was formed at Sofia-Vrazhdebna.

1946

January Training of the first cadre of 40 student pilots and 60 student technicians started with the newly-formed People's Air School, named after Georgy Benkovsky, a 19th-century Bulgarian national hero.

6 February 2nd Attack Polk declared the best unit of the air arm, achieving the best

The Arado Ar 96B-2 was the main advanced trainer in the Fighter School in the 1940s. Many ex-Luftwaffe examples were taken as war prizes from Yugoslavia.

Arado Ar 196A

This Ar 196A-3 of the 161st Floatplane Reconnaissance Squadron shows the yellow theatre band introduced in 1941. A few VNVV aircraft retained this after the 1944 coup.

1939 and 1940. The serviceability of the fleet was extremely poor and only nine B 534s were considered combat-ready in the first days of the operations. After the first weeks of active combat work, the serviceability in the orlyak fell to such a low level that no more than one to three aircraft were available at any time. The archaic B 534 proved extremely effective in both the close air support and reconnaissance roles. Used mostly against troops and soft targets, and occasionally for visual reconnaissance over the battlefield, the B 534 was armed with four 7.92-mm machine-guns and up to 80 kg of bombs. These were accurately delivered at ultra-low level, causing considerable damage to truck and horse-drawn cart convoys. Close-range reconnaissance of the battlefield was done on behalf of the strike units of the Vazdushna Escadra. Operating at the threshold of its combat radius of just over 300 km (186 miles), the B 534s of 2/2 Orlyak flew a total of 71 missions with 140 combat sorties, during which they suppressed 22 artillery batteries, destroyed or damaged 52 trucks, four tanks, 62 horse-drawn carts, one railway convoy and one railway station, in addition to providing the escadra with more than 100 reconnaissance reports. The 2/2 Orlyak's CO alone flew 65 missions in the B 534 and two more in the Ju 87D-5, acting as the leader of the Stuka groups. Two aircraft were lost during their dangerous missions over the battlefield, which was well-protected by small-calibre AAA, and one was extensively damaged. There were no casualties.

The bomber assets of the escadra were grouped in the 5th Bombardirovachen Polk, controlling two orlyaks – 1/5 with 11 Do 17P/Ms and 2/5 with 21 B 71s. The latter flew only four combat sorties, leaving the lion's share of the workload to the crews of the Do 17-equipped 1/5 Orlyak. They were put into action on the very first day of the war and continued pounding the enemy rear positions, roads and railways until late November, in addition to performing occasional long-range reconnaissance missions on those days when 73rd YDR's aircraft were totally unserviceable. 1/5 Orlyak flew a total of 362 combat sorties without losses, destroying or heavily damaging 173 trucks and cars, 42 railway cars, seven combat vehicles and more than 10 aircraft on the ground.

Air reconnaissance

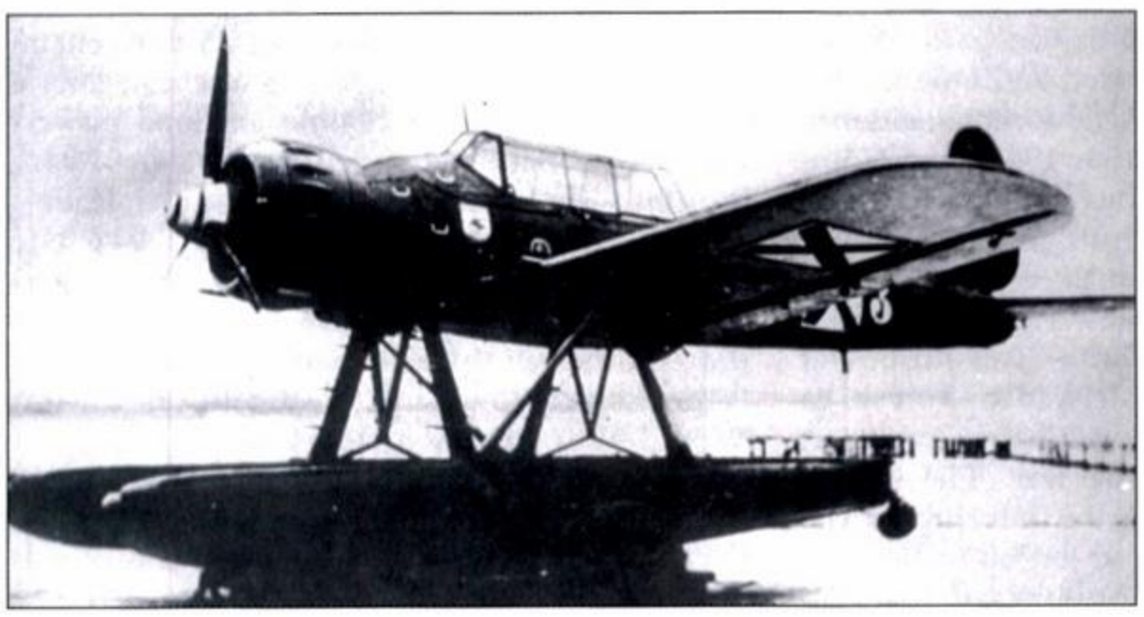
Reconnaissance-gathering for the field armies was the responsibility of the 1st Rasuznavatelen Polk, while the supply of reconnaissance information to the supreme command of the country's armed forces and the escadra was provided by the 73rd YDR. The former unit, initially controlled by the escadra, had two operational orlyaks, 3/1 and 4/1. The first controlled two yata – the 333rd RY with seven Fw 189A-2s and the 334th RY with five Fw 189A-2s. In September 1944 they were moved to the forward operating base at Varba near the Serbian border and tasked with under-taking reconnaissance for the 1st Army and 4th Army, respectively. 4/1 Orlyak controlled two yata – the 453rd RY with nine S-328s and the 463rd RY with nine KB-11s. They were moved to the forward airfield at Petrach near Sofia and tasked with supporting the 1st Corps and later the 2nd Army.

Conditions were challenging – the situation on the ground was complex and changed rapidly. The first task of both long- and close-range reconnaissance units was to pinpoint the defensive positions and installations of the enemy troops and also to determine the current location of the units of the retreating Bulgarian occupation corps. Close-range missions were carried out initially 20 to 60 km (12 to 37 miles) behind the front line by a single aircraft or a pair, once or twice a day. Long-range missions were carried out by the 73rd YDR up to 300 km (186 miles) behind the lines once or twice a day, but later this figure increased to four sorties a day with the Do 17s of 1/5 Orlyak.

On 8 October the Fw 189s of 3/1 Orlyak mounted their first ground attacks on truck convoys located immediately behind the front line. Eight trucks and several combat vehicles were destroyed with machine-guns and bombs. On 17 October the 333rd RY made its debut in the artillery control role, directing the fire at the Strazhin strongpoint. The only air-to-air encounter happened between a Do 17P of the 73rd YDR and four unidentified fighters over Bitolya in Macedonia in November. The Do 17

Twelve Arado Ar 196A-3 floatplanes were taken on strength with the 161st Vodosamoletno Yato (Floatplane Reconnaissance Squadron) of the 1st Polk in April 1943. They were used for Black Sea patrols and anti-mine operations.

The most modern World War II-era reconnaissance aircraft of the VNVV was the Fw 189A-2. Eighteen aircraft entered service with 3/1 Orlyak in 1943 and 14 took part in the war, occasionally on ground-attack duties.



training results. 1/2 Orlyak was chosen to be the VV standard bearer.

20 April Commencement of the VV's longest flight of the 1940s. A Parliamentary delegation was flown to the meeting of the Interparliamentary Union in Copenhagen by a Ju 52/3m of the Air Transport Yato.

25 May Two Yak-9M pilots escaped to Italy during a routine exercise.

2 July Parliament introduced the Armed Forces Control Law; 400 wartime officers of the air arm were immediately dismissed.

15 September The Bulgarian Parliament proclaimed a new official name for the state – People's Republic of Bulgaria.

Late 1946 Delivery of 30 Tu-2T torpedo bombers to the 25th Mine-Torpedo Aviopolk at Balchik.

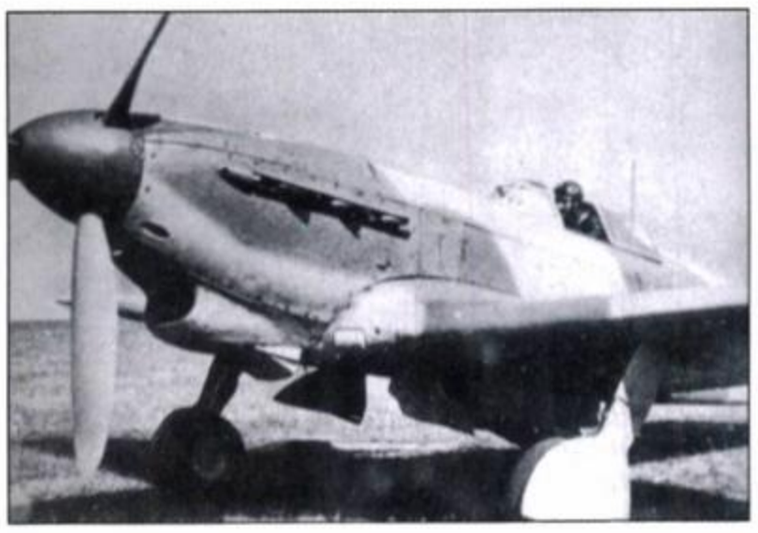
1947

19 March Three Ju 52/3M transports, two Fw 58 and three Fi 156 liaison aircraft were transferred to the newly-formed Air Transport Directorate, directly controlled by the government.

1 May Civil Aviation Service within the headquarters of the air arm disbanded.

June First Tu-2 aircrew conversion course with the 25th MTAP started at Balchik.

9 September Some 25 Yak-9s headed by Maj. Stoyanov, commander of the VV's fighter force, took part in a flypast over Sofia to celebrate the third anniversary of the 1944 coup which brought the Communists to power.



Above: The first Yak-9Ms were handed over in the summer of 1945. They eventually replaced the Bf 109Gs within the four component orlyaks of the 6th Fighter Polk in late 1946.

Below: Ninety Yak-9Ms were supplied in 1945 in addition to 30 Yak-9U/UTs and some Yak-9Ds. The pictured aircraft wears the Soviet-style national insignia, adopted in late 1949.

The first night-fighter squadron of 10 Yak-9M/P pilots commenced training by early summer of 1949. These versions were equipped with a searchlight and radio compass for the night role.

was extensively damaged, but eventually it escaped into the clouds and made a belly landing on Bulgarian territory. There was suspicion that the attackers were Italy-based P-51 Mustangs of 15th Air Force. Heavy flak over the battlefield resulted in the shooting-down of one Fw 189 and one KB-11, the crews being killed. A number of aircraft and crews suffered from heavy damage, but managed to return to their bases. During the Bulgarian offensive 3/1 Orlyak flew 315, 3/4 flew 138, and the 73rd YDR flew 125 combat sorties.

The temporary liaison/air transport yato, based at Vrazhdebna, had on strength two Do 17s and two Ju 52s, which provided a supply of personnel, equipment and mail to the headquarters of the field armies. A number of Fi 156 Storchs were assigned to the front-line orlyaks, the escadra and the supreme command for use in the liaison role.

After the end of the battles in southern Serbia and Macedonia, the 1st Army joined the 3rd Ukrainian Front of the Red Army advancing toward Austria via Serbia, Croatia, Slovenia and Hungary. The German-made VNVV inventory was suffering from severe unserviceability by the end of 1944 and the front-line aircraft were not able to participate in the battles, which happened more than 1000 km (621 miles) from Bulgaria. The close air support of the 1st Army was provided by the Soviet 17th Air Army. The air assets of the 1st Army were grouped in a liaison yato of two Fi 156s and one Bf 108 based at Zemun. One Do 17P of the 73rd YDR flew reconnaissance and liaison missions in March 1945. Ju 52/3ms flew some transport missions in support of the 1st Army. One Fi 156 with its crew of two was lost on 10 May to enemy small arms fire.

On 31 March 1945 a new fighter squadron of 6 Polk – the 642nd Yato – was formed at Pech airfield in Hungary. It was to convert to the Lavochkin La-5 fighter and then take part in the closing battles of the war. The 9 May capitulation of Nazi Germany interrupted the process and the pilots instead ferried to Bulgaria large numbers of war booty aircraft that had been captured in Austria, comprising more than 100 Bf 109G/K fighters and a significant number of Ar 96 trainers.

During the last months of the war the Ju 52/3ms of the Prenosno Yato were involved in the air bridge from Vrazhdebna to Podgozitza and Nikshich airfields in Yugoslavia, transporting humanitarian supplies to the stricken Montenegro and Dalmatia regions.

The total number of sorties flown by the VNVV during the Patriotic War reached 4,424. Some 3,374 were flown during the first stage of the war between 9 September and 2 December, losing a total 32 downed or heavily damaged aircraft and 18 crew members. The fighter pilot Captain Stoyan Stoyanov was declared the Hero of the Air Escadra and awarded the highest Bulgarian wartime decoration – the Military Bravery Cross 3rd State.

Post-war changes

Bulgaria – which, though only a small country, occupied a position of strategic importance in the heart of the Balkan Peninsula, the crossroad between Europe and the Near East – fell into total dependency on the Soviet Union in late 1944. The 'spheres of influence' division of Europe, agreed in 1944 in Yalta between Stalin, Churchill and Roosevelt, called for very strong Soviet influence in Bulgaria. The Allied influence in the country was divided 75 per cent in favour of the Soviet Union and 25 per cent in favour of Britain and the US. Two years later a hard-line Communist regime assumed power. All pro-monarchist and liberal parties were promptly suspended and their popular leaders either killed or jailed. In July 1946 the Communist-led government took direct control of the armed forces. On 5 September 1946 the country was proclaimed to be a People's Republic as the monarchy was dethroned. Most World War II-era officers were dismissed immediately and some were later jailed due to their anti-Communist attitude and actions. Establishing control of the armed forces was one of the most important aims of the

1948

January Maj. Gen. Zakhary Zakhariev appointed C-in-C.

1 January 14th Transport Aviopolk formed at Vrazhdebna.

8 April Two pseudo-civil air training schools formed at Gorna Oriahovitza and Plovdiv in order to avoid Paris Peace Treaty restrictions on the post-war military pilot training in Bulgaria.

15 May The pilot of the sole VV He 111, used as a VIP transport, escaped to Istanbul in Turkey during a ferry flight from Vrazhdebna to Lovech. A month later the aircraft was returned to Bulgaria.

June The People's Air School, named after G. Benkovsky, moved from Sofia to its new permanent location at Dolna Metropolya in northern Bulgaria.

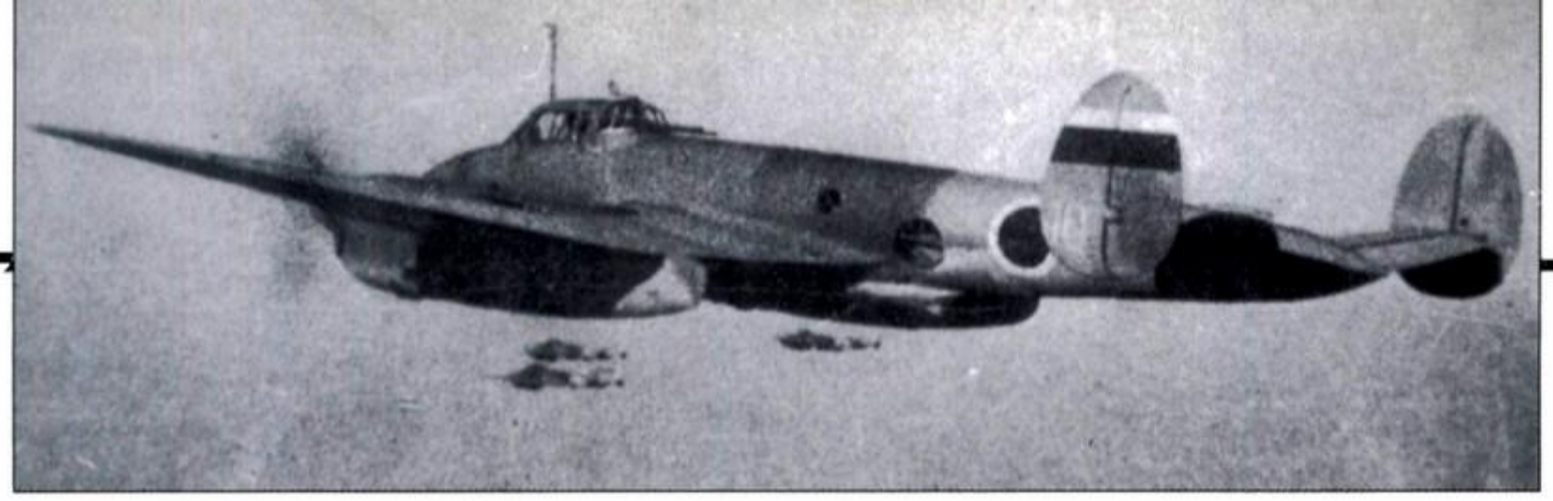
8 June Air Technical School formed in Sofia.

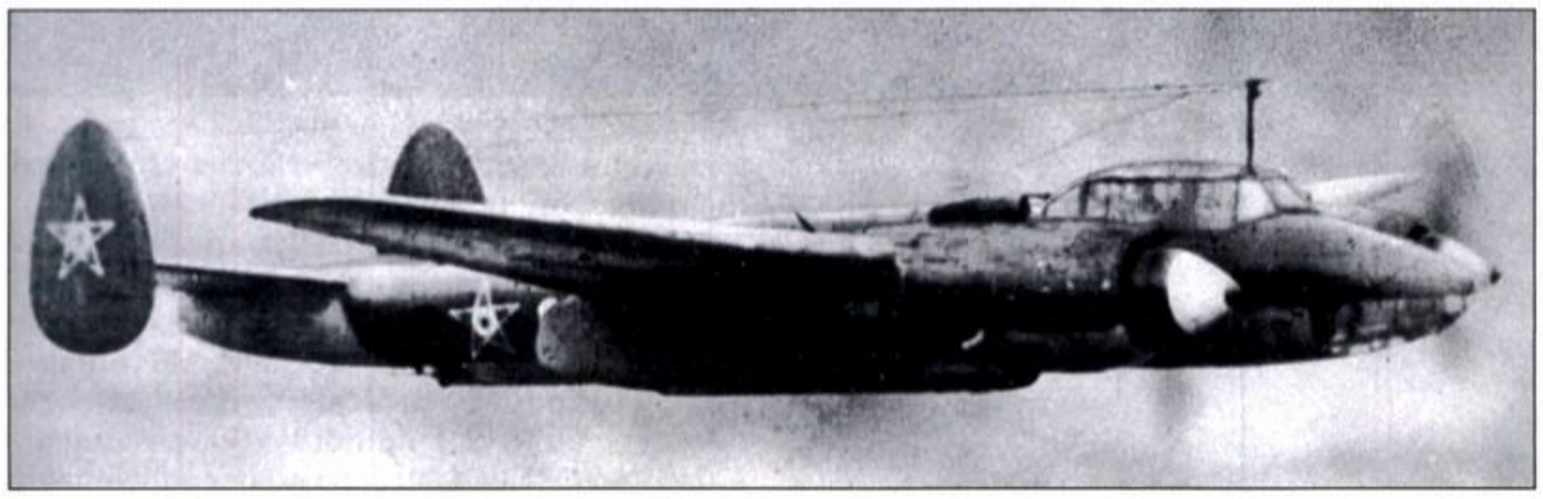
12 June First flight of DSF Laz-7.1 training/light attack prototype, designed for a contest for a new-generation trainer for the newly-restored Yugoslavian air arm.

30 June Former VV high-ranking officer Mikhalakiev hijacked a Ju 52/3M of the Air Communications Service, killing pilot Maj. Gen. Ganev and injuring the other crew.

September 2nd Attack and 6th Fighter Polks expanded to division size.

First female group commenced flying training with the People's Air School.





The bomber and recce units of the air arm, renamed Vazdushni Voyski (VV – Air Force) in early 1945, were re-equipped in mid-1945 with 98 brand-new Petlyakov Pe-2 dive-bomber/ reconnaissance aircraft. This Pe-2 wears the national insignia adopted in 1945.

Left: Thirty Tu-2T torpedo-bombers entered service with the Balchik-based 25th Mine-Torpedo Aviopolk in late 1946/early 1947. This aircraft wears the post-1949 national insignia.

The main transport type of the Bulgarian air arm throughout the 1940s was the Junkers Ju 52/3m. In March 1947 two aircraft were transferred to the newly-formed Air Transport Directorate.

The Fw 58 was used by the VNVV for a variety of roles, the primary one being the photo mapping, instrument- and multi-engine training.

Communists and was fulfilled in co-operation with numerous Soviet military advisors, who followed the supplies of large numbers of Soviet-made heavy arms. The 'Sovietisation' of the Bulgarian armed forces commenced in early 1945 and was successfully completed by early 1949, on the eve of the Cold War, when a strong pro-Stalin Communist regime ruled the country.

The full-scale reorganisation of the structure of the air arm took place in December 1944, initiated by a small group of Soviet-trained Bulgarian officers who had actively participated in the war, serving with the Soviet Air Force. They were headed by Major General Zakhary Zakhariev, a famed Spanish War-era bomber pilot and Hero of the Soviet Union, who was the Commander of the Tambov Air School of the Soviet AF during World War II. The reformed air force, from the official title of which the words 'His Majesty' were immediately deleted, emerged in January 1945. Now named Vazhdushni Voyski (Air Force), the service consisted of headquarters, two main air commands and direct-reporting services. Major General Gancho Manchev was appointed C-in-C and his deputy was Major General Zakhary Zakhariev. The two main air commands were the Vazhdushni Stroevi Chasti (Front-line Air Units) and the Vazdushni Uchebni Chasti (Air Training Units). The former, under the direct command of Zakhariev, comprised the 1st Rasuaznavatelen Polk, 2nd Shturmovi Polk, 5th Bombardirovachen Polk, 6th Iztrebitelen Polk and independent liaison, floatplane and air transport yata. The latter controlled the Air School and the three advanced flying training schools – fighter/attack, instrument flying and gunnery, as well as the communication and technical training schools. The paratroop battalion and the AAA polks were retained under VV control for four more years. The direct-reporting services of the VV comprised the Technical Service Directorate, the Supply Service and the Civil Aviation Service. The Technical Air Service controlled the aircraft production and repair facilities at Lovech, Kasanlak and Karlovo.

The general structure of the main front-line units remained close to that of the World War II era. Each polk (a unit similar to the Soviet air division) controlled two or three orlyaks (wings or regiments), each based at its own airfield. The orlyak itself comprised three yata (squadrons) of 12 fighters or nine bombers each and a staff flight of three or four aircraft.

The 16 March 1945 agreement between the Bulgarian and Soviet governments paved the way for the first large-scale supply of defence equipment to the Balkans state. The VV took delivery of 120 Yakovlev Yak-9M/U fighters, 120 Ilyushin Il-2m3 attack aircraft, 98 Petlyakov Pe-2 dive bomber/reconnaissance aircraft plus 10 Yak-9 and 10 Il-2 two-seat conversion trainers. The majority were delivered in the late spring and the summer when the simultaneous conversion of all front-line units had commenced. The huge numbers of Bf 109Gs, delivered factory-fresh in June and July 1945, were gradually phased out. The last Messerschmitt fighters served with the 6th Polk until late 1946 but several examples were retained to serve with the Telish-based Fighter School until the late 1940s. The fate of about 40 surviving D.520s was similar – immediately after the end of the war, the French-made fighters were transferred to the Fighter School where they saw a brief use before retirement and scrapping in 1947.

Yak deliveries

The first two Yak-9Ms were delivered to the VV in the spring of 1945. Conversion training of the fighter pilots commenced at Balchik and later at Karlovo and Bojourishte, where the orlyaks of the 6th Polk were permanently deployed. The final conversion of the aircrews of the four orlyaks was completed by mid-1946. The first batch of 120 Soviet-made fighters comprised 90 Yak-9Ms, about 30 Yak-9U/UTs and several long-range Yak-9Ds.

In 1948, 30 more Yak-9Ps were delivered. The peak in combat training of Bulgarian fighter pilots was reached in mid-1949 when the first night-fighter squadron of 10 pilots from the 36th Aviopolk (the former 3/6 Orlyak) started training at Vrazhdebna with the help of one Soviet instructor. The night training was abruptly interrupted in late 1949 and restored three years later by the pilots of the MiG-15-equipped 10th Iztrebitelna Aviodivisia. The Yak-9s remained in front-line service until late 1952, when they were finally replaced by Yak-23 and MiG-15 jet fighters.

The 120 Il-2m3 attack aircraft equipped the 2nd Polk at Graph Ignatievo where they replaced both Ju 87D-5s and B 534s. The Pe-2s were delivered to the 1st and 5th Polks at Gorna Oriahovitza, Yambol and Plovdiv, replacing the Do 17M/P/Ks and B 71s in the

1949

January 2nd Attack and 6th Fighter Divisions merged as 6th Fighter/Attack Division.

Air Traffic Control Service formed within VV.

9 February Two Turkish AF Spitfires shot down by the VV's AAA over the coastal town of Sosopol, 60 km from the border.

March First flight of the Fi 156 drone, upgraded by the VV Technical Service.

25 April First flight of the DSF Laz-8.

June First flight of the second DSF Laz-7.2. Start of the production of the first batch of 10 Laz-7 training/light attack aircraft at Zavod-14 factory, Lovech.

First Yak-9 night-fighter squadron of 12th Aviopolk begins training at Vrazhdebna.

September First group of VV pilots and staff officers sent to the Soviet Union for education in staff academies.
The name of the air arm was changed from Vazdushni Voyski to the Soviet-style Voennovazdushni Sily. The national insignia also changed to the Soviet-inspired five-pointed star with the national roundel inset.

29 September First flight of the production representative Laz-7.3 prototype.

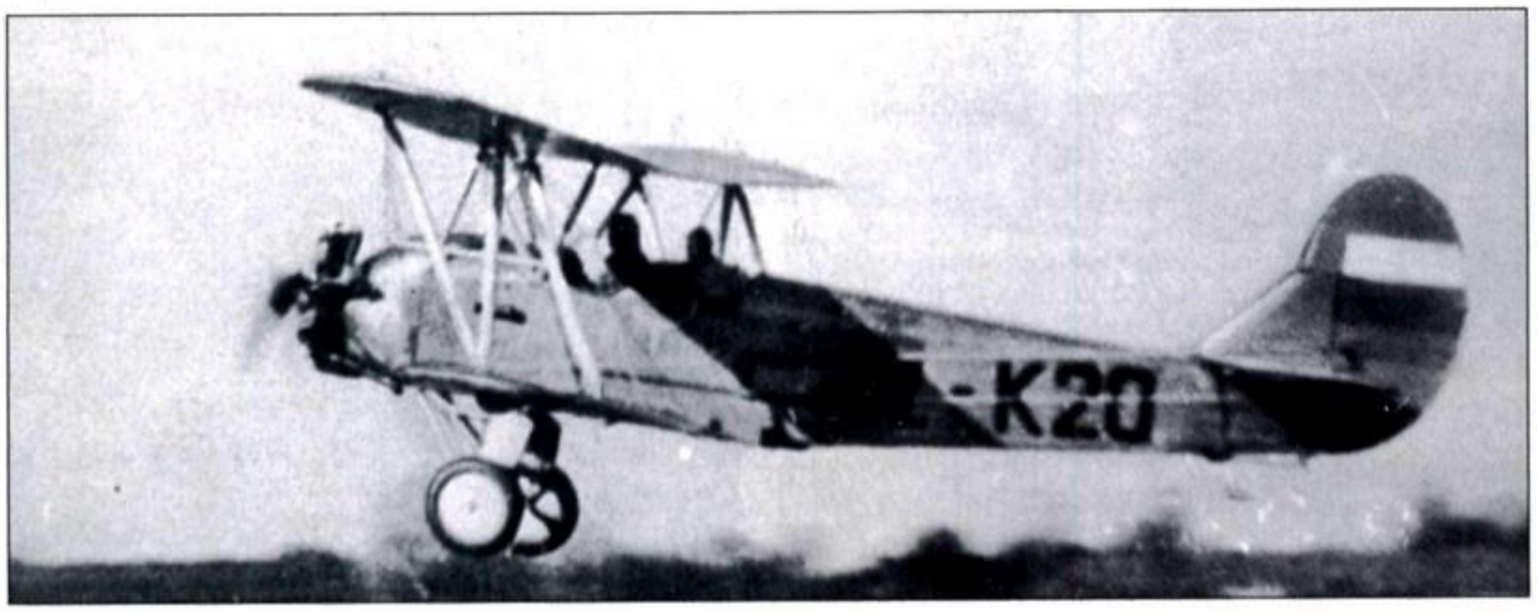
Late 1949 Laz-7 training and light attack aircraft taken on strength with the People's Air School.

Delivery of Po-2 training and liaison aircraft.

A Decade of Air Power

The Yak-11 trainer entered service in 1948. Initially used as a conversion and continuation trainer with the Yak-9, and later with the Yak-23-equipped squadrons, it was adopted as a basic trainer by the People's Air School in early 1950.

Below: The Polikarpov Po-2 initial training and liaison aircraft entered service in small numbers in the late 1940s.



bomber role and the Do 17Ms, Fw 189A-2s, S 328s and KB-11s in the reconnaissance role. The surviving Fw 189s, Fi 156s and Fw 58s were assigned to the front-line reconnaissance and bomber units for use as liaison and trainer aircraft, while both the S 328 and the KB-11 had been withdrawn from active use by 1946. The Il-2s were supplemented and gradually replaced by the improved Il-10s in 1951, and the Pe-2s were retired in 1955/56. In late 1946 36 units of the torpedo-bomber variant of the best Soviet-made piston-engined bomber – the Tupolev Tu-2T – entered service with the Balchik-based 25th Minnotorpeden Aviopolk. The conversion training of the aircrews of the first Bulgarian torpedo-bomber unit started in the summer of 1947. The Tu-2Ts were supplemented and then replaced by the jet-powered Il-28 'Beagle' in 1954 and 1955.

Another event that considerably affected the future of the air force was the 1946 Paris Peace Treaty which established the post-World War II order in Europe. As a member of the losing side for four years during World War II, Bulgaria suffered from certain sanctions, including payment of reparations to both Yugoslavia and Greece. The VV was forced to take part in this, delivering 30 KB-11 reconnaissance aircraft, 100 Bf 109G fighters and nine DAR-9 initial/basic trainers to Yugoslavia, and returning the Do 17Ka-1 bombers captured in 1941. The treaty also imposed certain restrictions on the numerical strength of the country's armed forces. The number of the front-line aircraft was considerably restricted and the VV was denied offensive aircraft types. The number of both the active and newly-trained pilots and navigators also came under severe limitations.

The restrictions of the treaty, however, proved to be easily circumvented using the services of Soviet advisors and the support of both the Soviet and Yugoslavian air forces. Some of the orlyaks of the 5th Polk were temporarily based in Yugoslavia, and aircraft operating in Bulgaria were stripped of their national insignias and codes. Small cadres of air and technical crews underwent training in Yugoslavia while a large number of pilots and navigators were trained locally under civilian cover between 1948 and 1950. A significant number of Pe-2s, 'hidden' in Yugoslavia, were taken on strength with the local units after Marshal Tito had severed his relations with the Soviet Union and the other Communist states in 1948.

The extensive purges of 'politically unreliable' VV officers, most of whom occupied important command positions, began in late 1946. By the same time, however, the number of newly-graduated officers, most of them members of the Communist Party, was insignificant. More than 400 officers, overwhelmingly World War II veteran pilots, were dismissed at once in 1946. By early 1946 the total number of VV personnel was 8,351; 1,324 officers were dismissed in 1946 and 1947, but the number of newly-graduated pilots in the same period was only 77. VV numerical strength fell to 47 per cent below the required peacetime level.

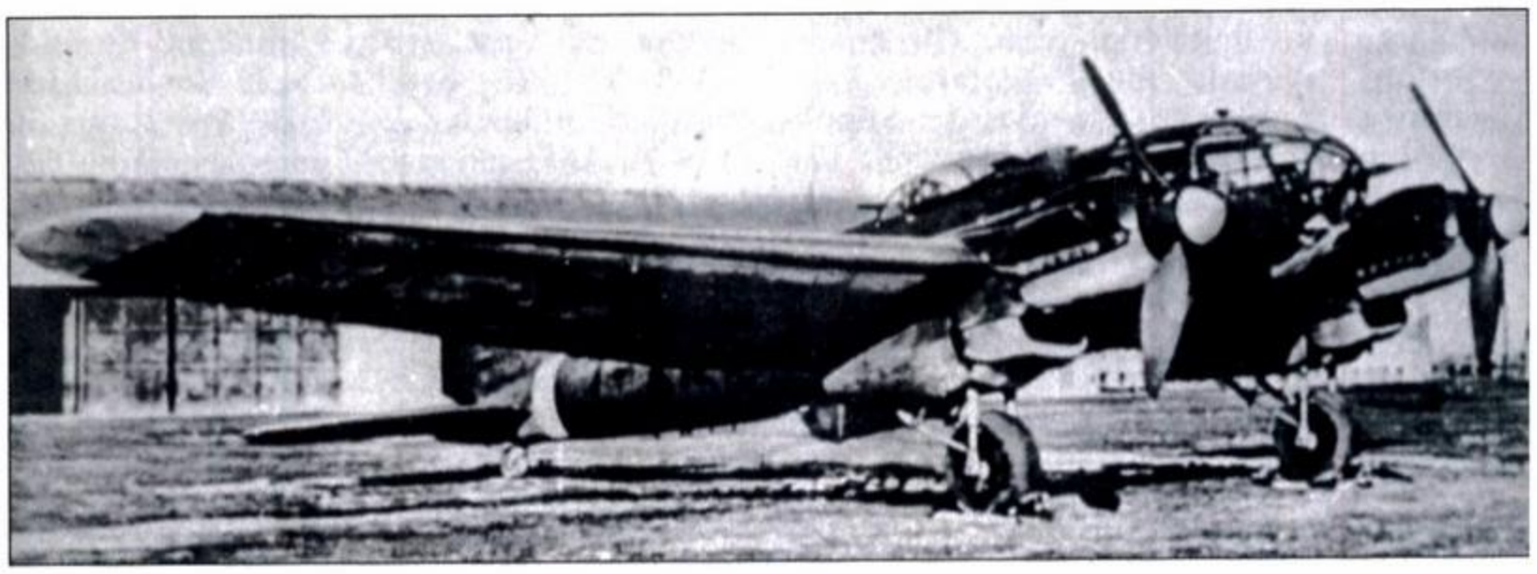
Defections

There were several incidents of experienced pilots escaping during training missions, the best-known being on 25 May 1946 when two officer pilots diverted to Italy during an exercise. Overflying Yugoslavia with their Yak-9Ms, they were able to complete their escape flight with a successful landing at an Italian airfield near Foggia. On 15 May 1948 the pilot of the sole VV He 111, used as a VIP aircraft, diverted to Istanbul in Turkey during a ferry flight from Vrazhdebma to the DSF repair facility at Lovetch. One month later the Turkish administration allowed the He 111 to be returned to Bulgaria.

The first Bulgarian airborne hijack took place on 30 June 1948. The former high-ranking VV officer Mikhalakiev, dismissed from service two years previously, killed the pilot of a Ju 52/3m and injured the other crew members. Seizing control of the aircraft, Mikhalakiev was able to reach Istanbul where he received political asylum. The pilot had been Major General Ganev, a former chief of the People's Air School and the then-current chief of the newly-established Air Transport Directive of the Bulgarian government that provided civilian air transport in the country.

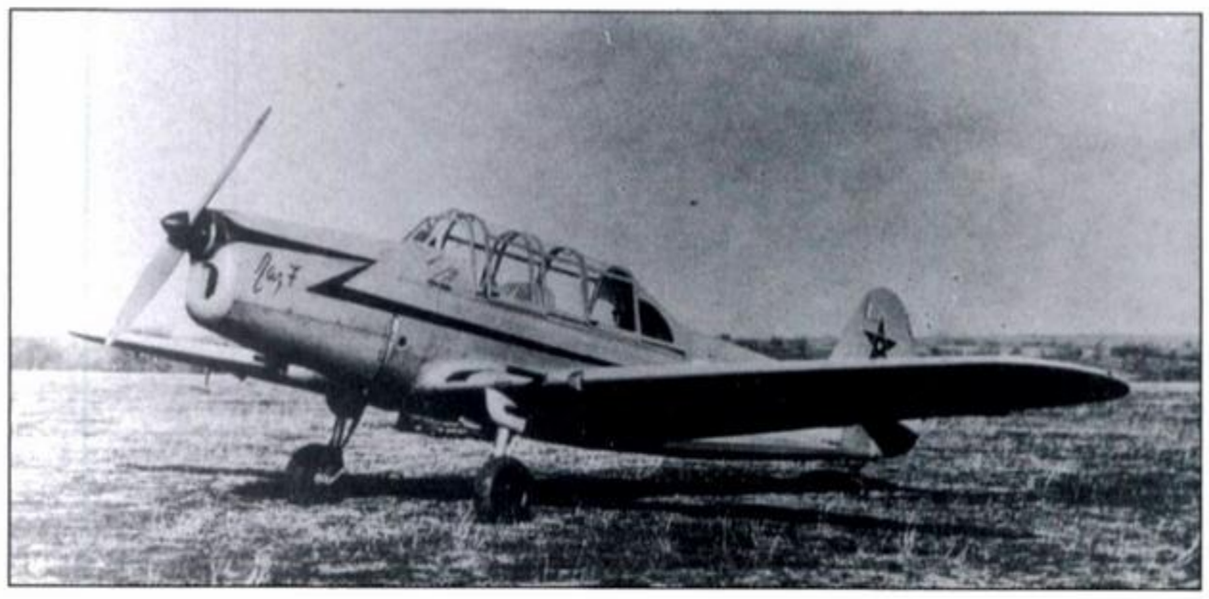
The ageing trainer inventory, the large number of trainees and the lack of sufficient instructor pilots caused serious problems in the

The sole He 111H-16, taken on strength in 1943, was used for VIP transport and instrument flying training. A pilot defected to Turkey in it in 1948.



Voennovazdushni Sily Order of Battle, December 1949

UNIT	AIRCRAFT	BASE
6th Fighter-Attack Division		***Sofia***
16th Fighter Aviopolk	Yak-9M/P/U (60)	Bojourishte/ Vrazhdebna
36th Fighter Aviopolk	Yak-9M/P/U (60)	Karlovo
2nd Attack Aviopolk	Il-2m3 (100)	Graph Ignatievo
25th Mine-Torp. Aviopolk	Tu-2T (30), Fw 189 (5), Fw 58 (4)	Balchik
15th Recon. Aviopolk	Pe-2 (30)	Gorna Oryahovitza
14th Air Transport Aviopolk	Ju 52 (5), Fw 58 (2), Bf 108 (1), He 111 (1), Fi 156 (3), W 34 (1)	Vrazhdebna
8th Recon. Floatplane Escadrila	Ar 196 (10), He 60 (3), He 45 (1)	Tchaika
People's Air School		***Dolna Metropolya***
1st (Initial Training) Escadrila	Bü 131 (10), Laz-7 (2), Fw 44 (10), DAR-9 (10), Po-2 (10)	Dolna Metroploya
2nd (Basic Tr'ning) Escadrila	KB-4/5(10)	Dolna Metropolya
3rd (Adv. Tr'ning) Escadrila	Ar 96 (9), Yak-9M (10), Fw 58 (2), Ju 52 (1)	Telish
People's Technical Training School		***Lovech***



Above: The Laz-7 was the most successful indigenous aircraft. This is the first prototype – the Laz-7.1. In the centre is Professor Tzvetan Lasarov, the chief designer.

This production standard Laz-7 light attack aircraft of the first batch was produced in mid-1949. A total of 163 was produced. The type served with two night bomber polks and also with the People's Air School, where it was used as an initial and basic trainer.

training process in late the 1940s, as the VV required as many new pilots as it was possible to train in-house. A new type for initial and basic training was badly needed; it came at last in 1949, in the form of the indigenous Laz-7.

The origins of the most successful Bulgarian-designed aircraft – the DSF Laz-7 – date to April 1946 when the prominent Bulgarian designer Professor Tzvetan Lasarov, DSF chief designer, was invited by the newly-restored Yugoslavian AF to participate in the contest for a new light aircraft which could be used in trainer, liaison and light ground attack roles. Lasarov completed the design drawings in only 40 days and submitted his project just in time. In July 1946 the Staff of the Yugoslavian AF judged the Bulgarian project to be the second best. One prototype, the Laz-7.1, was built by the DSF factory at Lovetch in 1947 and made its maiden flight on 12 June 1948. After the completion of its flight tests in August it was sent for evaluation by the Yugoslavian AF, but later crashed due to wing structural failure. Although the aircraft had good flying characteristics and easy handling, the VV did not approve the Laz-7.1 for production. The Laz-7.2 second prototype made its maiden flight in June 1949 and was soon followed by a third, similar to the final production configuration – the Laz-7.3, which took the air on 29 September 1949.

To hasten Laz-7 production, the first batch of 10 ordered in June 1949 by the VV was based on the Laz-7.2 standard. Two machines of the first batch were tested by the NVVU in 1949-1950. The other eight were delivered to the night light-bomber aviopolks – 24th and 29th NLBAPs, based at Stara Zagora and Yambol – formed in 1950. The Laz-7 entered regular service with the People's Air School in 1950. A total of 163 (including the prototypes) Walter-Minor 6-III-engined Laz-7s was produced between 1949 and 1951 by the Zavod-14 plant, the former DFS factory. They were followed by 150 more M-11FR-engined Laz-7Ms, the last of which was handed over in 1954.

Armed trainer

Due to the lack of light attack aircraft within its inventory by the late 1940s, the VV adopted the aircraft for front-line use with the newly-established night light-bomber polks, which later grew to division size. In this role, the Laz-7 was armed with two wing-mounted and one turret-mounted 7.92-mm machine-guns and up to 120 kg (265 lb) of bombs, either six 20-kg bombs or two 50-kg bombs. In 1958 about 120 Laz-7/7Ms were transferred to the pseudo-civil aeroclubs for use in initial and basic flying training until the late 1960s. A four-seat liaison and light VIP-transport aircraft, the Laz-8, was based on the Laz-7.1. A single example was built in April 1949 and, after testing, entered service with the VIP flight of the 16th Transport Aviopolk at Vrazhdebna, where it served until 1958.

By 1949, Bulgaria had become one of the most reliable Soviet satellite countries in Eastern Europe, and particularly the Balkans. Its main enemies were considered to be Greece and Turkey, then NATO candidate members. Another potential enemy was its former ally Yugoslavia, because the Marshal Tito-led regime had halted all relations with the Soviet Union and other Communist countries and embarked on an independent development of the state, turning toward the West for delivery of arms and industrial co-operation. By the end of 1948 the two main VV front-line units – the fighter and attack polks – had been retitled in the Soviet style as divisions: 2nd Shturmova Divisia (Attack Division) and 6th Iztrebitelna Divisia (Fighter Division). Major General Zakhariev was appointed C-in-C in late 1948. Each division comprised two or three aviopolks (wings), each of which in turn was made up of three escadrili (squadrons).

In early 1949 the strength of the main front-line units was considerably reduced. The two existing attack and fighter divisions were merged into the 6th Iztrebitelno-Shturmova Divisia (Fighter-Attack Division), controlling two fighter and one attack regiments with a total of nine combat squadrons. The other main front-line units were the regiment-size aviopolks (wings) – 25th MTAP (mine-torpedo regiment), 15th RAP (reconnaissance regiment), 14th TRAP (transport regiment) and 8th RVE (reconnaissance floatplane squadron). This temporary reduction in both the number and the inventory of the units was dictated by the insufficient number of pilots and technicians left after the extensive purges of the World War II-era personnel between 1946 and 1948. The NVVU started training a large number of new aircrews, expected to enter service by 1950 in order to meet the planned expansion of the early 1950s. The strengthening of the air arm became a high priority in 1949 as the Cold War in the Balkans gathered speed daily, and small incidents near the southern borders of the country began to occur with increasing frequency. The best-known of these was on 9 February 1949 when two Turkish AF Spitfires were shot down by small-calibre AAA over the coastal town of Sosopol.

New title

The extensive 'Sovietisation' of the air arm led to the change of its official title in late 1949, becoming identical to its Soviet counterpart – Voennovazdushni Sily (VVS). The VVS structure was similar to that of a Soviet front-line air army. The national insignia also changed: the white-and-red roundel with a horizontal green rectangle inset introduced in 1945 was replaced by a Soviet-style five-pointed red star with the small national roundel inset. It was used until September 1992 when the simple high-visibility white-green-red national roundel was adopted.

The availability of large numbers of new aircraft allowed two more units to be formed in 1950. The 4th fighter and 5th attack divisions each controlled three aviopolks plus two night light-bomber aviopolks. The first VVS unit – the 26th IAP, crewed by newly-graduated pilots, all of them Communists – was sent for jet fighter conversion to the Soviet Union in the spring of 1950. On 1 July 1951 the first Yakovlev Yak-23 jet fighters of the VVS made their first flights in Bulgaria at the main fighter base at Graph Ignatievo, marking the beginning of the jet era in the history of the air arm. This stage of the VVS reorganisation was completed in late 1952, when the fighter aviopolks eventually converted to the jet-powered Yak-23 and MiG-15. By the mid-1950s, just in time for the establishment of the Warsaw Pact, the VVS had at last achieved its desired status as a potent air arm, able to provide air support and air defence in both defensive and offensive operations against its long-time enemies of the Cold War – the NATO member states of Turkey and Greece. **Alexander Mladenov**

A few aircraft of the 1940-49 period survive in Bulgaria, mainly in the air force museum at Plovdiv, including this Yak-9U, an Ar 196A, an Il-2m3 and an LAZ-7M.

B-26 Invader in Korea

Douglas B-26 Invaders, many of them veterans of World War II, flew the first and the last bombing missions of the Korean War. In between were three years of blood, toil and sweat, at high and low level, by day and by night.

The Invader was probably the most versatile combat aircraft in Korea, its duties ranging from low-level intruding to medium-level formation bombing, the latter demonstrated by these 13th Bombardment Squadron B-26Bs and Cs flying from K-8 (Kunsan AB), circa 1953.

In 1950, the United States Air Force was undergoing some drastic changes in the way it did business. World War II had ended just five years previously and the general public had no interest in the problems its military forces might be facing. The Cold War had begun and, with the development of the atomic bomb, the threat of war with the Soviet Union was far more dangerous than anything that had been generated by the battles fought in the past war. Both world powers were focused on converting to an all-jet force as soon as possible. Scores of aircraft designs were on the drawing boards and production lines were rapidly accomplishing this goal.

However, the Korean War brought reality back into the picture. The fact that the jets could not wage a war hundreds of miles from their bases was brought to light in late June 1950. There were two factors involved in this: the jets' fuel consumption was far beyond the capacity of their internal tanks, and the crude air bases in South Korea were unable to accommodate the fast movers. The Soviet Union was also made aware of this problem, but it was not affected because it had no intention of putting aircraft into such forward bases as the USAF was doing. The Soviet air regiments that operated from Manchuria were dealing with long, paved runways and with a much shorter radius of combat sorties.

Return of the Invader

This situation generated the need for the conventional prop types to be brought back, in quantity. Two aircraft in this category were to be considered the super achievers during the entire 37-month span of the war, both bombers and both having seen extensive World War II service during its final stages: the Boeing B-29 Superfortress and Douglas B-26 Invader. They were available in quantity when the Korean War began and they were still in heavy use when the war ended on 27 July 1953. Although the F-51 Mustang and F-80 were intensely involved in the war, they had been replaced by the new fighter-bomber version of the F-86 Sabre in early 1953. Official records indicate that FEAF had only 553 aircraft assigned to operational squadrons when the Korean War started, including 22 B-29s and 26 B-26s.

On 25 June 1950, the first day of the war, two squadrons of B-26s were operating from Japan, while the closest B-29 outfit was operating from Okinawa. The distance factor enabled the B-26 to claim the honour of having been in harm's way for the longest period. The 8th Bomb Squadron of the 3rd Bomb Wing entered the fight early on, flying the first bombing missions into North Korea, and when the war ended one of its B-26s was the last to fly a bombing mission.

Flying the first and last bomb sortie of the war ensured the Invader its place in the history books, but its accomplishments between are what endeared the aircraft to its crews and to the ground troops that were slugging it out in the trenches. The Invader's interdiction tactics contributed significantly to preventing the Chinese from mounting a sustained offensive. A vast majority of these missions were flown at night. The overwhelming numbers of UN fighter-bombers overflew the Communist supply lines during the day, forcing all movement of supplies and material to be carried out at night. The primary and secondary supply routes over North Korea were covered, at night, by six squadrons of B-26s and one squadron of Marine night-fighters.

Token force

The once-dominant American Forces in the Far East had dwindled to a token force, especially with no potential adversary in sight. The troops were under strength and their conditioning was far below par. Those first few

The nerve centre for Communist forces was Pyongyang, an area under constant attack from just about every type of UN aircraft. This picture shows part of a force of 48 Invaders of the 452nd Bomb Wing heading for the North Korean capital in July 1951.

weeks were pitiful. The North Korean Armed Forces were at full strength, with a strong armoured force of Soviet-built T-34 tanks. However, their air forces were not state-of-the-art because the Soviet Union had not yet supplied any jet aircraft, so they were stocked with World War II-vintage fighters. The task at hand for the US was not dealing with North Korean air power, but stopping the onslaught of manpower that was surging, unchecked, into South Korea. The B-26s got the call as the 3rd Bomb Wing was rushed into the fray. Their aircraft were all battle-worn attack aircraft that had seen a lot of combat in the Pacific during World War II. Colonel Virgil Zoller, commanding officer of the 3rd, states, "When the war broke out, we were basically a typical World War II light bomb outfit. Fifth Air Force had not quite completed its transition to all-jets. We were the only unit that was capable of carrying a sufficient bomb load with plenty of range. Naturally, we got the call."

By the afternoon of 25 June, the Far East commanders were scrambling around trying to gather what few aircraft they had. It just so happened that the 8th Bomb Squadron (3rd Wing) had been deployed to Ashiya AB, Japan for a FEAF air defence readiness test on 24 June; this put them in close proximity to South Korea. At the time, they only had 10 operational aircraft. However, the safe evacuation of Americans from Seoul was the top priority. The first aircraft to see combat action in the war were F-82 Twin Mustangs and F-80s, which provided top cover for the C-54s flown in to pick up evacuees.

On 5 April 1951, when this view was captured, a large number of 452nd Wing Invaders were involved in performing daylight, bomber-stream formations with 500-lb and 1,000-lb GP bombs. In June, the 452nd cut back on the daytime missions, joining the 3rd Wing in safer night attacks.

Below: Like many B-26s, in Korea,* Brown Nose *of the 13th BS flew (as an A-26) in the previous war, as evidenced by its olive drab paint.

Maximum effort

On the afternoon of 27 June, a weather front swept over the northern half of the South Korean peninsula. It would delay effective bomb strikes against the NKPA's advancing columns by at least 24 hours. In the meantime, the 8th's sister squadron, the 13th 'Grim Reapers', had moved its B-26s from Johnson AB, Japan to Ashiya, so both squadrons were ready to wage war. On the night of 27/28 June, a directive came from FEAF HQ to put up a maximum effort of B-26s to attack a large tank column approaching Seoul. It proved to be totally ineffective.

To begin with, six of the 10 8th Bomb Squadron B-26s on line were being used to fly an around-the-clock escort over the *Reinholte*, which had been evacuating civilians through the port at Inchon. The ship was now en route to Fukuoka, Japan and the 8th had been ordered to stay with it continuously. The squadron launched the remainder of its aircraft at dusk. The weather was so bad that cloud cover prevented them from seeing anything worth bombing, so they returned to base without dropping any ordnance. The North Korean Army was able to advance at least 50 miles (80 km) further, without attack from American air power, due to the weather conditions. This advantage was felt later on when the Pusan Perimeter was closing up.

On the evening of 28 June, weather conditions were still bad over Japan, but reconnaissance over South Korea had indicated the skies were clearing; if the aircraft could get airborne from Itazuke AB and Ashiya AB, they should be able to bomb targets of opportunity with good results. The first bomber strike was launched from Ashiya at 07.30 on 28 June. Twelve B-26s in the force were able to bomb the rail complex at Munsan, inflicting extensive

B-26s went after not just rail bridges, but also the labourers who repaired them. In this picture, taken south of Pyongyang, a 730th Bomb Squadron Invader is dropping para-frags on the suspected quarters of the work force. Note the rail bridge in the background.

Below: Invaders of the 731st BS, 452nd BW return to Itazuke, Japan after a low-level sweep over Communist targets, May 1951. Note the replacement fin on the near, camouflaged B-26B.

Right: During a break in the weather, B-26Bs of the 729th BG lend a hand to the embattled Marines around the Chosin Reservoir during the harsh winter of 1950-51.

These 729th BS Invaders are led by one of the glass-nosed C models over the mountainous terrain of North Korea in March 1951. At this time, MiG-15s were very active around the Yalu River, so most daylight B-26 sorties were flown well out of their way.

damage on North Korean boxcars loaded with equipment and munitions. They drew some accurate ground fire, and one of the light bombers was damaged and had to land at Suwon. The next day, it was strafed on the ground by several Yak fighters.

On the afternoon of 29 June, the B-26's presence in the war was finally felt by the enemy. It had taken over 72 hours to receive permission to cross the 38th Parallel into North Korea.

The weather breaks

The weather front had loitered for close to 48 hours, and now there was nothing in the way. At 16.15, 18 B-26s loaded with frag bombs launched from Ashiya to attack the main airfield at Pyongyang. This mission was planned so that all aircraft would be dropping their bombs at dusk along the line of hangars, revetments and parking ramp. The mission achieved outstanding results, due to the element of surprise. It was estimated that 25 aircraft were destroyed on the ground. Only one Yak-3 got airborne to oppose the attack and it was shot up badly by one of the Invaders.

At 19.30 on 30 June, the 3rd Bomb Wing got a big break. The Australian Prime Minister announced that his government had made the decision to commit its No. 77 Squadron's F-51 Mustangs to the UN effort. Their main base was at Iwakuni, Japan, very close to South Korea. This meant that the 3rd Bomb Wing would move to Iwakuni and cut its flying time to the front lines. The wing operated from here until it made a permanent move to 'Kunsan-by-the-Sea', on the west coast of South Korea.

In a desperate attempt to stem the tide of the North Korean offensive, FEAF diverted B-29s from their missions far to the north and brought them below the 38th Parallel for the purpose of bombing troop concentrations north of the Han River. Overall, these strikes were not very effective. On 30 June, one day after the successful B-26 strikes on the airfield at Pyongyang,

Lt Hans J. Petermann, Bombardier/Navigator/Radar Operator, 8th BS

"Not all missions go according to plan! One night I was flying in the back of a C model as radar operator. On climbing out, after take-off, I began to smell gas fumes and I immediately reported it to the pilot. A few minutes later, it was getting worse and I told him that I was going on 100 per cent oxygen. I told this to the pilot and he became concerned and immediately asked me for more information. At that time, my interphone transmission malfunctioned and I could not answer him. I could hear him and the other crew member conversing and they were worried that I had passed out from the fumes. An immediate return to base was authorised and the pilot stated that no switches on the aircraft were to be activated. I finally thought to start communicating via flashlight. I could see the engine props from my windows and I started flashing my light on them. After several times, the pilot noticed the flashes. We began to communicate by my flashing on the left prop for yes and the right for no. This let him know that I was still OK and that the fumes were still strong. We landed back at Kunsan, pulled off the main runway and shut down. Emergency personnel were waiting. The bomb bay doors were opened and gasoline poured out from the bomb bay. We debriefed and thought our night was finished ...' but, that was not to be. We were assigned the back-up Invader and went ahead with our mission. We were aware that the first mission could have been a disaster before we had crossed the bomb line.

"I can recall another mission that is still vivid in my memory. On this mission, I became greatly disturbed because the pilot would not adhere to established guidelines! This was that the navigator had the responsibility to constantly monitor the terrain elevation where we were operating and advise the pilot when he should pull up from an attack. This was, generally, at least a 500-ft margin and sometimes more, depending on the pilot. This one was to be my 42nd mission and we would be in a B model. The pilot was on his 'cherry' (third) mission. I was riding the right seat and monitoring the altimeter with great intensity. He repeatedly ignored my warnings to pull up when I perceived that with his inexperience we were getting too low! I reported my concerns to our operations officer, about the pilot ignoring my warnings. I requested that I not be assigned again to this pilot because I believed he would not survive. It was the only time in my career that I expressed a refusal to fly with a pilot. He and his crew did not return from his fifth mission!!"

Lieutenant Hans Petermann prepares to climb the ladder into the bombardier's station of his 8th Bomb Squadron Invader* Sweet Bettye. *The 8th as well as the 13th squadrons flew a large number of the hard-nosed B models, but the C was well dispersed among all units.

Prior to loading this B-26B for a mission, the ordnance crew spread out the ordnance requirements for the upcoming mission. The load for this aircraft of the 728th BS suggests a mission against road traffic, summer 1951.

Versatile Lady, *one of the most colourful B-26s in Korea, was flown by Capt. Tony Curto of the 13th BS. It is seen here in 1951 at Iwakuni when the 3rd BW was marking its 10,000th combat sortie.*

Below: A 728th BS Invader makes a bomb drop from altitude, prior to dropping down and using napalm. The 500-lb GPs were probably being used against suspected troop concentrations.

the Invaders were ordered to load every available aircraft and hit enemy troops in and around the Seoul area. They used every type of ordnance they could load, to bomb, strafe and rocket these fluid targets. The mission comprised 18 bombers from both the 8th and 13th squadrons.

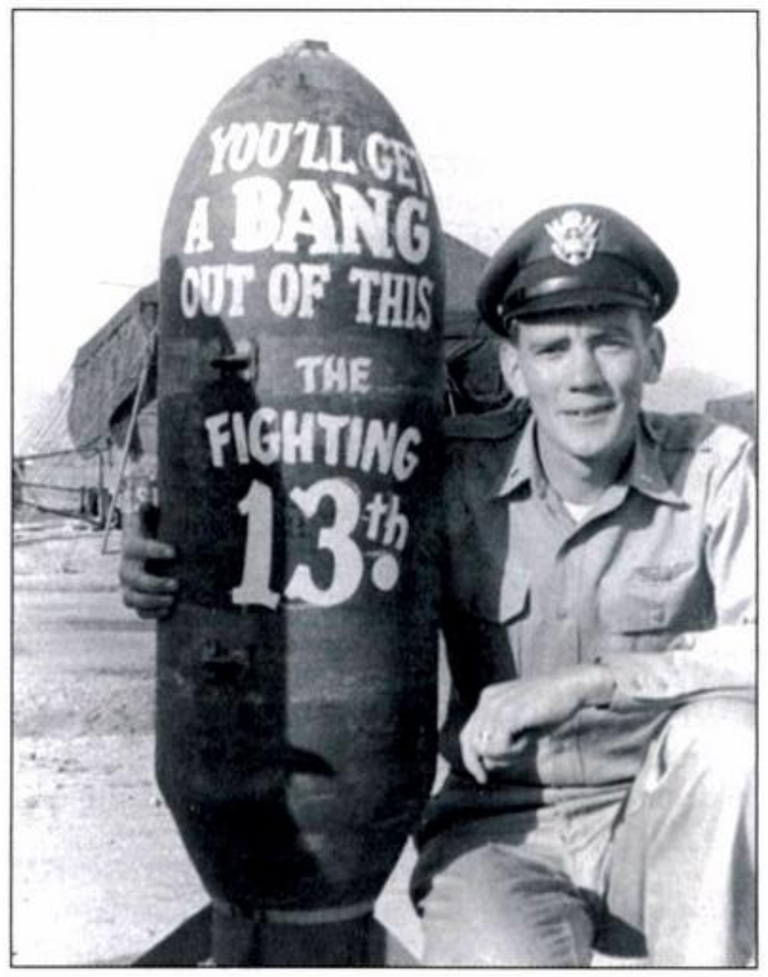
The 13th either had perfect timing or had finally hit a lucky streak. A flight of 'Grim Reapers' aircraft was running some low-level checks on the railway bridges leading into Seoul when it found a large number of North Korean tanks and trucks jammed up on a road leading to a bridge under repair. The column was bumper to bumper, so the vehicles could not manoeuvre out of the way. The B-26s made one pass, wingtip to wingtip, dropping everything they had. The column went up in a series of fiery explosions. This was probably one of the biggest setbacks suffered by the Communist forces in the first weeks of the war.

Wrong mission

During the first two weeks of the North Korean invasion, both bomber types in-theatre had been worked beyond belief. The number of available targets were more than they could handle. During all of this confusion, several understandable mistakes were made involving selection of targets. Initially, the B-29s were tasked to bomb troop concentrations and the B-26s were sent after highway and rail bridges. The missions should have been reversed, as the Invaders were best suited to go against the moving ground targets and the Superfortresses could have dropped the bridges with their massive bomb loads.

A large percentage of the 3rd Bomb Wing's Invaders were fitted with the hard nose, which housed eight 0.50-in guns. These B-26B models had up to 14 forward-firing machine-guns. The aircrews in both squadrons flew these aircraft in the most effective way: very low level and extremely aggressive. They were perfectly suited for running the roads and destroying anything that moved. The targets were so plentiful that, in a majority of the missions, it was lack of ordnance, not fuel, that brought the aircraft back early. At the onset, only two aircraft types could be utilised to their maximum: the B-26 and F-82. They could operate from Japan and still have enough fuel to loiter in the areas where they were needed.

Right: 13th Squadron pilot Lt Joe Kostohryz poses beside one of the bombs that he would be delivering to the enemy in a few hours. Most of the personal messages painted on the bombs originated from the ordnance units.



13th Bomb Squadron navigator Lt Harry Galpin (on the left) poses with one of the pilots he flew with on several missions at Taegu AB (K-2) during the early months of 1951. The yellow-trimmed B-26s in the background, were assigned to the 8th Bomb Squadron. The 3rd Bomb Wing staged out of this base for several weeks before moving to its permanent base at Kunsan (K-8).

Below right: Medium altitudes were just as dangerous as low altitudes in the face of accurate flak batteries. This 730th Bomb Squadron Invader was involved in a formation bomb drop, in daylight, from a respectable altitude. The flak was intense and accurate, resulting in damage that could have proven fatal if it had been any closer.

Major Robert Fortney poses by his personal mount The 7th Chadwick, *which replaced the aircraft involved in the action described here. Fortney had flown P-47s in the Pacific in World War II.*

Major Robert Fortney, CO, 13th BS

"It was my good fortune to fly a hard-nosed B-26B named *6th Chadwick*. The *Chadwick* series dates back to the 13th Squadron's exploits in World War II, when the first *Chadwick* was an A-20 Havoc. These aircraft had always been assigned to the squadron commanders. My aircraft carried the tailcode 'Y'. Shortly after I took command, I had Corporal Earl Brooks paint the front half of the Invader a bright red colour, to show off the 13th's colours. He also painted the girl that adorned the side of the aircraft.

"I can recall a close call we had, one night, when we returned to base with the aircraft heavily damaged. I don't remember exactly the route that we were flying that night, but we were almost finished with our targets, and I had several 5-in HVARs still in place. We spotted a long line of moving vehicles on a road and I lined the bomber up for a rocket pass. The terrain in this area was relatively flat, so I figured I could get right in on them at a very low altitude. The rockets, even though mounted under the wings, gave off a bright glare when they were fired and it was much worse because it was pitch black outside. If you fired with both eyes open, you could be blinded for a short period of time, which was long enough to hit the side of a hill or mountain.

"We were lower than usual and when the rockets zeroed in on the targets, they created a huge explosion, throwing debris up into the air. As it turned out, I was so low I flew into all the debris, which included a lot of mud. This caused several holes to be punctured in the nose and splattered considerable mud on the windscreen. Something also hit a control rod of the prop on the right engine. I was no longer able to control the pitch of the prop, but it was set so that I could continue to fly it without having to feather. We did make it back safely to Kunsan AB (K-8).

"The fate of the *6th Chadwick* was sealed a short time later, when one of my pilots, Lieutenant Joe Johnson, upon returning from a mission, decided he would do a barrel roll. He did complete the roll but, in the process, he warped the wings badly enough that the aircraft had to be Class 26'd."

The road between Pyongtaek and Seoul proved to be a problem. It was packed with columns of tanks and trucks ... all headed south. Ordinarily they would have been easy prey, but these North Korean reinforcements had brought a large number of AAA batteries along to protect the equipment. The area was saturated with daylight sorties from the B-26s, F-82s, F-51s and F-80s. Between 7 and 9 July, FEAF claimed to have knocked out 44 tanks and 176 trucks, all in this area; one B-26 had been shot down and heavy damage had been inflicted on others. Something had to give. The treetop-level attacks were proving too costly, and the aircraft were forced to move up to medium altitudes to survive the ground fire.

The change in altitude called for a change in tactics for the 3rd Bomb Wing. The answer was to use the glass-nosed B-26Cs to lead the formations. The problem was that the 3rd only had eight C models, which had to be divided between the 8th and 13th squadrons. Additionally, aircrews began devising the best methods for aiming their bombs from the hard-nosed B models. The results were good, so as long as the Invaders were involved in the daytime operations they continued to rack up good hits. Once the '16-gun' B-26s had released their bombs, they dropped back down on the deck and headed due south, at full power. If they encountered anything moving on the roads or rails as they headed back to Japan, they worked it over with their 0.50-in guns. They had come and gone before the triple-A could react.

FEAF soon realised that the role of the B-26 in the Korean conflict would not be diminished, regardless of how long the war lasted. The only other light bomber type in service was the new B-45; it was not available in quantity, though, and was certainly not suited to the type of low-level missions, flown in darkness over mountainous terrain, that the B-26 performed. The answer was to bring more Invaders into the war. On 30 July, the 452nd Bomb Group (Light) was activated for duty in Korea. This Reserve unit, operating from Long Beach Municipal Airport, consisted of four Bomb Squadrons: the 728th, 729th, 730th and 731st. By 10 August the 452nd had moved up to George AFB to begin an intensive combat training course. During this period, B-26s were removed from storage at Hill AFB and flown to California. All four squadrons had to be up to full combat strength before they headed to the Far East.

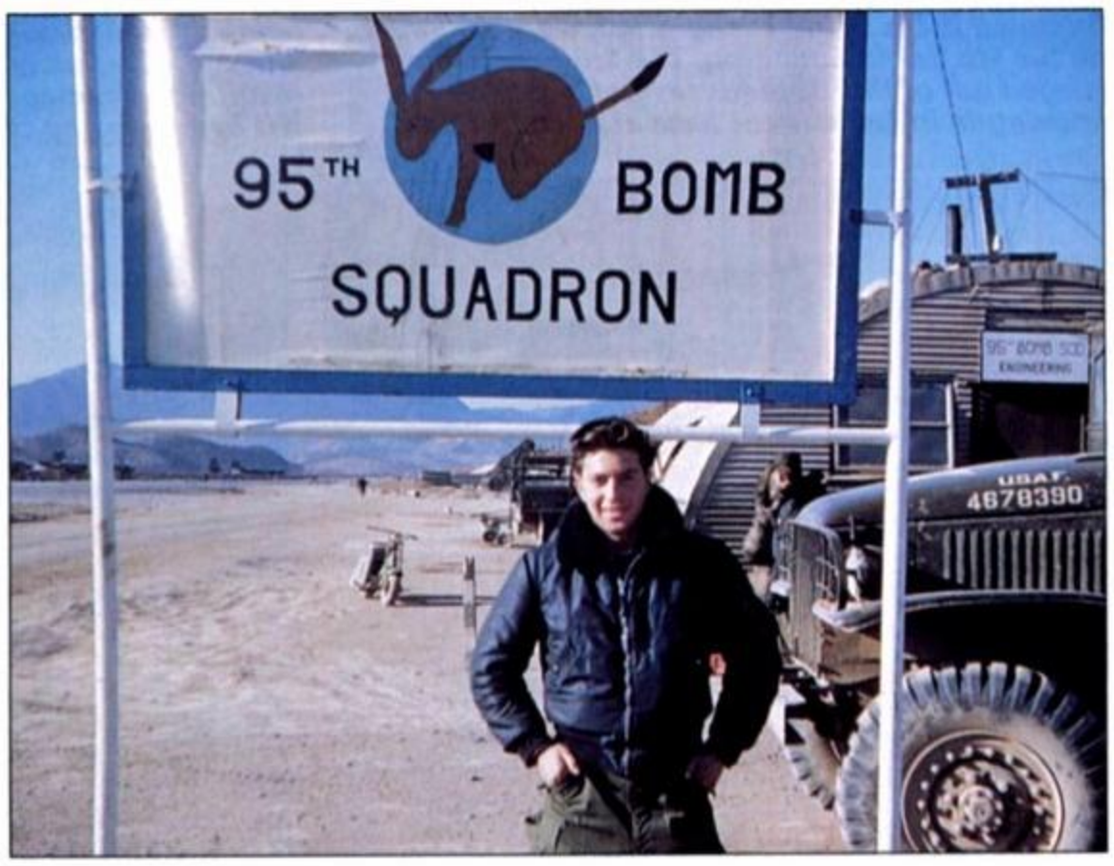
Night missions

Some of the earliest night missions flown by the 3rd Bomb Wing were when the war was at its lowest ebb. The Pusan Perimeter had tightened to where the fighter-bombers operating from Pusan were only two minutes from their targets. At this point, the war had taken on a new facade.

The only thing saving South Korea up to this point was the mighty air arm of the UN. The North Korean military leaders were under a tremendous amount of pressure to push the defenders off the peninsula.

All movement of supplies during daylight hours had ceased. That only left one alternative: to move the required material and equipment during the hours after dark when fighter-bombers were forced to stay on the ground.

Lieutenant Charles Bartels, a pilot in the 13th Bomb Squadron, reflects on one of his early



Above: These 13th Bomb Squadron Invaders have been loaded and their crews are ready to start engines. This was probably going to be a daylight formation bomb drop from medium altitude. The 13th's primary mission was night intruding or interdiction.

Right: In between snowy weather fronts at K-9 (Pusan East) on 27 January 1953, Sergeant Paul Geidel poses in front of the 95th Bomb Squadron sign outside the unit's engineering section.

The *Chadwicks*

Right: 13th BS CO Robert Fortney runs up the engines of* The 7th Chadwick. *Note that the red trim extended even to the barrels of the guns.

In Korea, the 13th Bomb Squadron carried on a tradition dating from World War II, in that each commanding officer's aircraft was given the name *Chadwick* in sequence, beginning with A-20 Havocs and continuing until the end of the Korean War.The name arose from the World War II practice of giving each tactical unit switchboard a codename. The arbitrary name assigned to the 3rd Attack Group was 'Chadwick'. One day in 1944, group commander Lt Col John P. 'Jock' Henebry was assigned a new A-20 Havoc of the 13th Attack Squadron (later, BS) and was pressed to decide on a name. He asked, "Why not Chadwick?"

An aircraft nicknamed *Chadwick* served with the 13th through the remainder of World War II, and the practice was revived in Korea. Most of these B-26Bs had a flying wheel painted on the fin, to indicate that a 'wheel' (an important person) was piloting the aircraft. There are no reliable records on the disposition of the first four *Chadwicks*, which were wartime A-20s. *The 5th Chadwick* was one of the first A-26 Invaders to leave the US for combat duty during World War II. *The 5th Chadwick* transferred to Iwakuni during the occupation and flew combat missions in Korea, a total of 217 in 1,201 combat hours. It is rumoured to have been shot down or to have ditched, but this is not known for certain. *The 6th Chadwick* was another B-26, serial -364 and coded 'Y'. It was assigned to 13th BS commander Lt Col Robert Fortney in Korea. The aircraft was eventually overstressed during a manoeuvre and was retired. *The 7th Chadwick*, formerly *My Darling June*, survived the war.

Left: Pacific war veteran* The 5th Chadwick *is seen with squadron aircrews at Iwakuni in September 1950.

Below: Also sporting World War II-era olive drab camouflage,* The 6th Chadwick *is seen with a selection of weapons at a display for the press mounted by the 3rd Wing at Kunsan.

Above:* The 6th Chadwick *later became the first to have large areas of red trim. Not long after this photo was taken, it was seriously damaged on the mission described opposite.

Below:* The 7th Chadwick, *its colours now much stained and faded, also received additional nose art and the name* Stateside Dream. *This seems to have been the last of the* Chadwicks, *but the 'Grim Reapers' later took their B-57s into combat in Vietnam in much the same roles as they performed in Korea.

night missions against the North Korean 6th Army. "It was 1 September and we were directed to an area that was close to the Han River. The US 25th Infantry Division was under attack. When we arrived overhead, an Army ground control unit marked the target with a few rounds of white phosphorous. I lined up my attack on an east to west heading, laying down a string of 100-lb GP bombs. These were released at intervals, so I could cover the entire line of enemy troops. Finishing this run, I banked sharply and lined up for a firing pass with my 50-calibres. I continued this pattern until I had run out of ammunition. The images that I witnessed are still fixed in my mind's eye. The North Koreans were forming up for a human wave attack against the 25th. In the bomb flashes, I saw nothing but masses of troops and they were catching the brunt of my attack ... full bore."

This attack prevented heavy casualties to US forces and saved the high ground that they were trying to hold. The body count made the next day was staggering.

The damage that the Air Force, Marines and Navy had done to the road/rail system should have stopped all movement, but it did not. The number of labourers used by the North Koreans will never be known because they were out in the open only during the night. Damaged rails were made usable in hours. Road repair took even less time. At one point, the enemy was constructing pontoon bridges at night, and hiding them during the day. This was discovered by B-29s dropping flares. The solution was to have B-26s drop delayed-fuse bombs along the path of the bridges. This hampered the work crews all night and did cause some delay, but the flow of supplies was not halted to the extent that it was noticed by the ground forces.

The 95th Bomb Squadron was not to be outdone in the squadron emblem department. Their aircraft all carried the famous 'kicking mule' which was the symbol of the 95th, shown here on the flight line at Pusan East in 1952. This emblem was adopted by the 95th in World War I.

Inchon landings

On 15 September, the US Marines pulled off a surprise amphibious landing at Inchon Harbour. It was very successful and caught the North Korean military completely off-guard, the bulk of their forces and equipment being concentrated at the 'Perimeter'. The Marines slashed eastward, cutting off the main supply routes of the NKPA. In a matter of hours, news of the manoeuvre reached the enemy forces and, in a well-timed attack, UN ground forces broke the noose that had been around their necks for over a month. The breakout was supported by hundreds of UN fighter-bomber aircraft. Their targets were out in the open and abundant, and the destruction of the North Korean armour was almost instantaneous.

With the breakout, the war took an abrupt 180° turn. The front lines moved northward rapidly, all the way to the Yalu River. By late October it looked like the war would be over

Invader nose art

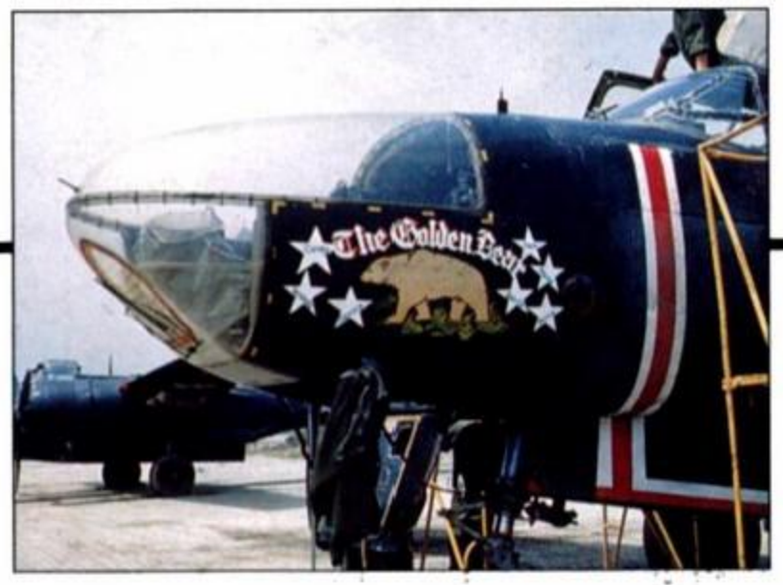
Moonshine *of the 8th BS was flown by Captain Jake Clements (second from left) and crew at K-8 in 1952.*

Little Sheba *was a 13th BS B-26C at Kunsan in 1952, with a particularly well-drawn lady aboard.*

Snafu *was a B-26C of the 8th BS at Kunsan, seen in 1953 after the building of revetments there.*

Linda *was another fine example of the nose artist's craft; this is probably a 90th BS aircraft.*

Rat *was a B-26C assigned to the 8th Bomb Squadron in the last months of the war.*



The Golden Bear *(44-34700) was assigned to the 34th Bomb Squadron in the late summer of 1952.*

Involuntary *(44-35958) of the 731st BS at Kunsan was one of the B-26 high-timers, flying over 170 missions.*

Miss Sandy *was the 452nd Wing commander General Sweetser's personal mount, seen here with its regular 729th BS crew, led by Captain Stuart Kalmus on the left.*

Below: 1st Lt Leroy Bain of the 13th BS at K-8 plays at being 'living nose art'.

before Christmas; however, all the hopes and expectations of the United Nations' forces were soon dashed by the enormous manpower the Chinese army hurled into the war. The pendulum of advantage swung in favour of the Communist forces. The victory which had been in sight crumbled in a matter of days, and the long retreat to the south began. Once again, the B-26s of the 3rd Bomb Wing were involved in round-the-clock operations and, this time, the number of targets far outnumbered anything they had ever seen.

24-hour air force

The next 90 days brought a big change in the Invader's combat tactics that lasted for the next 28 months. FEAF had realised that they would need a 24-hour Air Force to win this war. The B-26s would fight in an arena that had, in the past, been reserved for only a handful of specialised warriors – total darkness.

With the completion of their accelerated combat training, the 452nd Wing began its long journey to the Far East on 15 October 1950. Their destination was to be Itazuke AB, Japan. Upon arrival, it was decided to send the 731st Bomb Squadron (Light Night Attack) to the 3rd Bomb Wing at Iwakuni AB, a move which would put both Invader wings at three squadrons each. The 731st had become very proficient in the night mission, so it fit in well with the 3rd's planned operations. The 452nd officially flew its first sortie over Korea on 27 October, exactly 77 days after the unit had been activated. However, it did not reach full strength until 15 November, when the remainder of the three squadrons' personnel and equipment arrived by boat.

The decision to convert the 3rd Bomb Wing to one of total night attack was made before the 452nd flew into combat. With the war only 10 weeks old, General Stratemeyer was ordered to make the change. The Air Force high command had come to the conclusion that, since the war had begun, the biggest weakness 5th AF had shown was its inability to take out moving targets at night. The enemy was getting through sufficient equipment and supplies to maintain pressure on UN forces, something General Vandenberg noted as early as 6 September. His comments were that "the 3rd should begin night operations at once and any gaps created in the daytime ops would be filled by the 452nd Wing when it arrived in Korea." Even this early in the war, it was obvious that the only way to contain an enemy with enormous manpower was to cut its supply lines. Little did the 5th AF command know that, in less than two months, they would be facing human wave attacks from the Chinese.

The 452nd's mission had developed into an extremely dangerous game. The daylight role put any low-level aircraft in harm's way: the ground fire was heavy and becoming increasingly accurate. Formation, medium-altitude drops were more the exception than the rule. To deliver ordnance effectively, it was necessary to 'get down low and take it to them'.

Captain Charles Kamanski, a pilot in the 728th Bomb Squadron, recalls his 10th mission, which earned him a Silver Star. It is a classic example of just how vulnerable the B-26 was when used in its most effective mode. "We were leading a strike against Sariwon, which is

A five-minute time exposure captures the landing of a B-26 at 22.30, 'somewhere in Korea' (in fact, it is Pusan East). The thinner streaks are from the bomber's wingtip navigation lights.

Colonel Virgil L. Zoller, CO, 3rd Bomb Wing

"I can recall a mission that I flew in mid-December 1950, with a member of the Press on board. The weather had turned bitter cold and the Chinese were in the thick of it. We launched from our base in Japan and about two and a half hours later we were at a very low altitude between Pyongyang and Chinnampo, North Korea. There was still plenty of light. We were below 1,000 ft and following a winding dirt road. Nothing was moving, but up ahead was a small village that appeared to be deserted ... but that was far from the case. As I came within range, I opened up and sprayed the huts with machine-gun fire and immediately drew a lot of return fire. The Chinese had several hidden gun emplacements and we caught it as we shot over the tops of the trees. We continued on our journey to the north.

"It was almost dark when I pointed out a wide, frozen river coming up ahead of us. It was the Yalu! We turned sharply and headed for the town of Sinuiju, which was a beehive of enemy activity.

Colonel Virgil Zoller, the commander of the 3rd Bomb Wing, climbs into the pilot's seat of his B-26C as the rest of his crew prepares for a night intruder mission over North Korea.

"My bombardier, riding up in the nose of our C model, stated that we were coming up on a series of buildings that looked like barracks. These were arranged around a larger structure that appeared to be a factory. We were still at a very low altitude, with plenty of airspeed. As the buildings came closer, we saw smoke coming from the large chimney of the factory. I dropped the nose even more, added power and came in with my 50s firing, and unleashed a couple of rockets. They converged on the building and exploded in a bright orange fireball. I was using armour-piercing rounds of ammo, so we were definitely doing some damage.

"Finishing the first pass, I swung around for another one. This time I opened the bomb bay doors, telling my bombardier to unload our 20-lb fragmentation bombs in the middle of the enemy complex. Not wanting to get hit by my own bomb blast, we increased our altitude a little. As we came in, I fired more rockets and fired the guns. Clearing the buildings, I could hear the distinct noise made by our bombs as they hit. Looking back, I saw that we had put the ordnance on target and we had started a series of fires that probably did even more damage to whatever they had in the buildings.

"The mission was not over yet! We headed south and in a few minutes I spotted a flickering campfire up in the hills. I was sure that I had some rounds left in the guns, so I made a high-speed firing pass over the fire. Suddenly, there were hundreds of twinkling lights all around the area. It was small arms fire coming up at us. Evidently, we had stumbled on a sizeable Chinese force that had camped for the night. Finally out of ammo, we headed back to base. The reporter that had been with us thought this had to be one of the most dangerous missions we had flown. At the debriefing, I hated to tell him that it was only a routine mission with very little action."

north of Pyongyang. Our orders were to hit anything moving south of the bomb-line. After my initial pass, I spotted an engine and several cars that appeared to be undamaged. The cold weather had set in as this was right after the Chinese had entered the war, and things were not going well. As I lined up for my pass, I noticed a lot of personnel in an open field that lay between me and the engine. I fired a couple of 5-in HVARs at the engine, while strafing the troops. I noticed that they were taking refuge behind what appeared to be kilns in a brick yard. I was coming in on the engine and cars, at treetop level. Suddenly, one of the kilns exploded, sending thousands of bricks into the air. No time to react ... I flew into the debris and it was like getting hit with a baseball bat! I was knocked unconscious and came to on the crosswind leg of a left-hand racetrack pattern. I looked up and there was a hole in the windscreen, and I was covered with blood and pieces of brick.

"When I got hit, I slumped over the controls. My navigator, Lieutenant Marvin Jackson, pulled me back and took over the controls. He got us back up to about 100 ft and turned it into the crosswind leg. We couldn't have been more than 50 ft off the ground when we got hit. I can remember my gunner, Sergeant Taylor, calling out that the leading edges of our horizontal and vertical stabilisers were flattened by the bricks. Fortunately, everything was working OK, so I decided to make another pass on the enemy troops. We expended all of our ordnance and made it back to a friendly base. That base was none other than Pyongyang. As they loaded me on a C-54 to be flown back to a hospital in Japan, I could hear the artillery fire in the distance. We were close to being run from the North Korean capital by the Chinese.

"As a result of that mission, I lost the sight in my left eye, but continued to fly combat in the B-26. I finished my tour with 55 missions."

Above: A dozen Invaders are pictured in a flypast over K-9 in 1952, probably at the time that the 452nd BW handed over to the 17th BW. On a combat mission the aircraft would not have formed up until much closer to the target.

Winter advance

By late December, the Chinese were moving plenty of supplies south and, due to the bad winter weather, they were not under the usual pressure from UN fighter-bombers and night-attack types. This situation translated into plenty of food and ammunition for their enormous army. The retreating ground troops could not get a foothold to stop the advance. If the main supply routes could have been interrupted for one week, the momentum would have been slowed.

Every available aircraft was committed to the battle, a move which did have an effect on the Chinese military during the month of January. The Chinese high command was sensing a swift victory and demanded that their field commanders maintain heavy pressure on the sagging UN forces. This proved to be a costly strategy, however: it put tens of thousands of troops in the open during the daylight hours, allowing the F-51s, F-80s and newly arrived F-84s to extract heavy casualties. Estimates for the first 26 days of January put the Chinese losses at 38,000 troops. Captured POWs confirmed that probably one-half of this figure was caused by UN air power. The B-26s and Marine night-fighters found plenty of targets at night from zeroing in on all the campfires.

Working the railroads

During the February/March period, 5th AF put a heavy emphasis on attacking the Chinese lines of communication. The 452nd Wing was assigned a large area that extended south of a line from Wonsan to Pyongyang. Its Invaders came in low and dropped parachute demolition bombs against the smaller rail bridges. At the same time, the 3rd BW was saturating most of

Ole 940 ***was a legend within the 3rd Bomb Wing. It was the war's high-time B-26. Assigned to the 90th Bomb Squadron at Kunsan, it was flown by just about every aircrewman within the squadron. It is seen here in the spring of 1952.***

Sgt Austin Freiwald, Gunner, 34th BS

"This mission was flown in the spring of 1953. We were on a rare daylight bombing mission just above the MLR. The target was an artillery position on the reverse slope at the base of a mountain. When we reached the target area, the cloud cover disappeared. We were at 15,000 ft under 'Tadpole' control. We were to come in over the front of the mountain and drop down the reverse slope. All went well and we released the bombs. I was in the gunner's compartment facing rear and observing the ground through the periscopic gunsight. I was to observe the bomb blasts and count the number of secondary explosions that might occur. The 10 500-lb GP bombs were still in a tight grouping about 200 ft below the aircraft when a terrific explosion occurred right in the middle of the bombs. The burst surprised me, and I jerked my head back from the gunsight and, in doing so, I saw through the top canopy, black puffs of smoke above me to the aft of us. I called out 'Flak' to the pilot and he immediately put the plane in a steep bank and pulled out of range.

"After we cleared the target and passed over the MLR to the south, I began to survey the underside of our aircraft with my gunsight. We had holes in the bomb bay doors, a large hole in the right aileron and a good-sized one in the right wheel door. I informed the pilot of the damage and he was most concerned about the hit we took in the wheel door, as the round had probably punctured the tyre. He lowered the gear in flight, but the wheel started rotating in the air stream and I could not tell if it had been hit. We returned to base, called in flak damage and began our approach. There were ambulances and firetrucks lined on the side of the runway. The pilot came in with the left wing almost touching the runway. He continued that way on a so-called two-point landing. As our speed dropped, the wheel in question touched ... no puncture and all was well.

"It was the debriefing that really upset me. We were asked all types of questions. I was the only one who had witnessed the blast in our bomb cluster. It was orange in colour, and appeared to be about 25-35 ft in diameter. The debriefing officer stated that we were all lucky to be alive. It was a blast from an 88-mm flak gun. Curious, I asked how the Chinese had got the 88-mm. His reply was that they had got them from the Russians and they, in turn, had got them from the Germans!! These guns were radar controlled and proximity fused. He also said that we were very lucky because the bombs, in that precise moment and precise location, had caused the proximity fuse to trigger! A split second one way or the other and it would have burst right below our Invader, taking us down and out. We might have been the first bomb crew to be saved by our own bombs!"

An unidentified 37th Squadron gunner straps in for the night's mission. This position afforded the best view for determining strike results, and the gunner could easily bring both turrets to bear on a column of enemy vehicles.

Major St Clair Thompson of the 34th Bomb Squadron 'Thunderbirds' poses by his squadron's operations shack at K-9 during the autumn of 1952. The 34th took over the aircraft of the 728th Bomb Squadron when the 452nd BG was inactivated and sent home. Pusan East was the main base for the 17th Bomb Wing until the end of the war.

Lieutenant James Becker, a pilot in the 13th Bomb Squadron, was flying during this period and he relates a mission he flew just after sunrise, when they caught a large number of Chinese troops in the open. "We were working an area just north of the 38th Parallel when we were vectored into an area by one of the T-6 Mosquitos. When we arrived, the Mosquito pilot told us to drop down lower and follow the markers being put out by a lone L-19 that was working at a very low altitude. We were loaded with four 1,000-lb bombs with proximity fuses. I came in below the minimum altitude for these bombs as I wanted to put them in the middle of the massed troops. The first two salvoed dead-centre. I immediately pulled up and over for the second and final drop. Again, we went down their throat. The pilot of the L-19 shouted, 'My God, the entire regiment is down!' The killed and wounded must have numbered several hundred. Whatever they had been planning had to be cancelled because my ordnance had broken their backs. I wondered how the L-19 could work so low without drawing a hail of ground fire. It seems that the Chinese were afraid they would draw too much attention to themselves from the close support aircraft in the area."

Above: This view shows the gunner's compartment of a B-26 and the dorsal turret. Just visible behind the DF 'football' is the periscopic sight used to aim this turret. There was another sight on the underside.

the major choke points with M-83 Butterfly bombs, which broke down into smaller packages and fluttered to the ground. They remained inert until something came along and disturbed them. As the convoys rolled through the area, they would set off numerous small explosions, disrupting the flow of supplies, sometimes for hours on end. Come daylight, the surviving vehicles would pull off the road and camouflage themselves for the day, but they had not been able to cover the required distance demanded of them by their logistics commanders.

The figures released by 5th AF for April showed that the Invaders were still extracting a toll on supply movements at night. The 3rd Bomb Wing claimed 16 locomotives and 227 vehicles. In May these numbers took a different twist when the 3rd destroyed only five locomotives, but 629 trucks. For the most part, when the Chinese moved large numbers of troops from Manchuria they marched en masse to the front lines, but, in some instances, a large number of troops were mixed in with the supply convoys. In a report filed by an airman shot down behind enemy lines, he stated that his captors were moving him to the north, at night. They came upon an area that a lone B-26 had bombed prior to their arrival. The fatalities were extremely high and dead bodies were stacked on carts, like cords of wood. The airman, who managed to escape his captors a short time later, reported that it was total chaos and that the number of wounded must have exceeded 200, with an even higher count of dead.

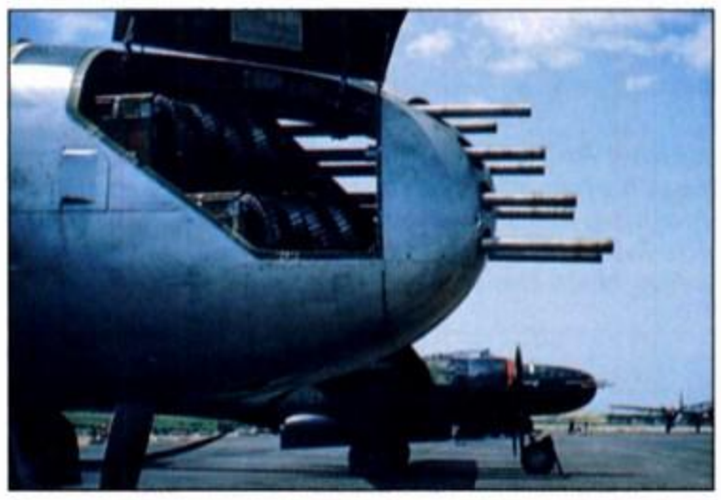
Left: The B-26 was one of the earliest 'Wild Weasels'. This B-26B from the 729th BS was named KTTV after a famous television station in the Los Angeles area. Its mission was to detect enemy radar emissions.

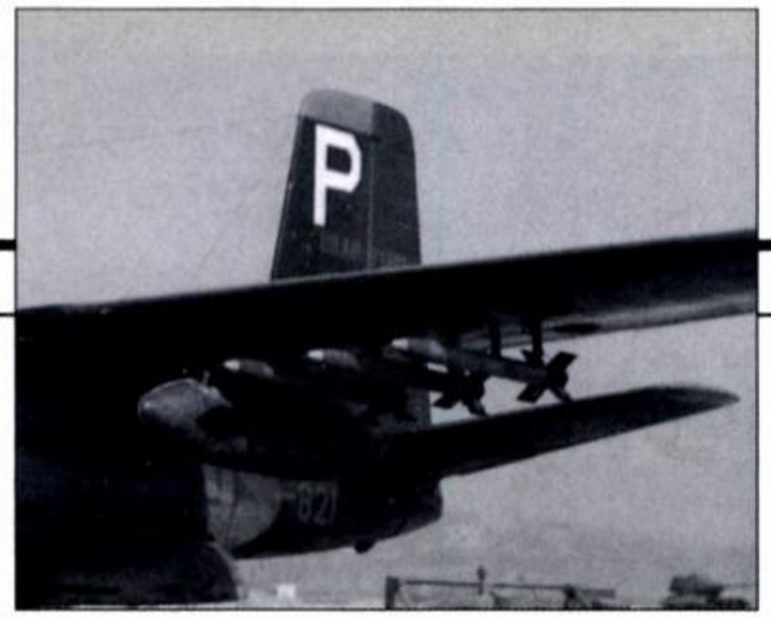
Both B-26 wings were constantly working up more effective tactics. During this period, they had modified several of their B-26s to carry a full bomb bay load of 52 flares. They would work their sectors in three-ship elements. The lead Invader would go down and drop flares over the convoys or rail traffic, immediately followed by attacks from the two trailing B-26s fully loaded with ordnance. The other facet of this tactic was to have two Invaders work the same area, each loaded with flares stowed under the wings. They took turns lighting the targets and dropping the bombs. It was an effective one-two punch.

At the time these tactics were utilised, the Chinese began moving an unusually large amount of supplies to the forward areas. Their big push had fizzled out and the lines were stabilising. The Chinese high command knew that if they gave the UN forces time to dig in, they would never be able to push them off the peninsula. It was this surge of traffic that put a damper on these tactics. 5th AF decided that they could not tie up two or three aircraft in one small sector and leave so many routes open.

Under normal circumstances, it took most of the available B-26s to cover their assigned part

Invader weapons





Above: A commonly used weapon was the 5-in rocket, seen here on 'zero-length' rails alongside a 500-lb bomb on a wing pylon.

Above right: This was the ultimate load of destruction for the Invader. The bomb bay has four 1,000-lb GP bombs ready for the night's mission out of Iwakuni AB, Japan. More than likely, this 731st Bomb Squadron Invader was going to hit suspected ammo bunkers or a major rail junction. The damage done by these bombs would have been difficult to repair in short order. The 731st specialised in the night intruder role.

Right: The ordnance crews prepare to load a container of the highly effective M-83 'Butterfly' bombs. These were dropped on high-traffic road junctions and known rail repair sites. They disrupted traffic for hours, hindering the flow of valuable supplies to the south.

Right: A close-up view of the Norden M-9 bomb sight mounted in the nose of a 13th Bomb Squadron B-26C.

Left: A pair of M-46 flash bombs used by the RB-26s to take night photos is displayed beside one of the aircraft. These proved to be very effective in illuminating potential targets, but the Invaders had to maintain altitudes of 7,000 to 8,000 ft (2133 to 2438 m) for good results.

Above left: The B-26B toted a phenomenal number of machine-guns for a twin-engined 'light bomber'. As well as this octet in the nose, there were three in each wing, and dorsal and ventral turrets held a pair each, making a total of 18.

of Korea. Thus, all operations went back to the single-ship strategy. The May figures released by 5th HQ confirmed that its air power had destroyed 827 vehicles that month. These figures were accurate and confirmed that the Chinese were indeed trying to get enough supplies to their troops to mount a sustained offensive. It was also a known fact that the majority of these truck kills were credited to the two night-flying B-26 wings.

Reconnaissance wing

Also during the early months of 1951, when UN forces were trying to stabilise the front and halt the Chinese advance into South Korea, 5th Air Force recognised the need for a tactical reconnaissance wing that would be based on Korean soil and be able to deliver accurate reconnaissance from all corners of North Korea. One of the most famous reconnaissance experts in the Air Force ranks heeded the call. Colonel Karl L. 'Pop' Polifka was brought in to form up the 67th Tactical Reconnaissance Wing, to be comprised of the 12th (RB-26s), the 15th (RF-80s) and the 45th (RF-51s) squadrons. The wing was officially activated on 25 February 1951; Colonel Polifka was shot down in an RF-51 over the front lines on 1 July 1951, listed as KIA.

The aircrews of the 12th TRS established some excellent procedures for obtaining high-quality photographs at night. They employed M-46 photoflash bombs for illumination, and the combination of the light intensity of these bombs and the good night cameras produced what was needed by the day fighter-bombers. The best results were usually accomplished at altitudes of 7,000 to 8,000 ft (2133 to 2438 m). To pull this off required precise navigation. It was not like sitting at altitude waiting for headlights to show up on the mountainous roads; they were assigned specific, fixed targets that were very difficult to locate in the dark.

If the B-26 and F-51 had one thing in common, it had to be their heavy attrition rate.

Above: Napalm blossoms around North Korean rolling stock as seen from a 730th BS B-26C. In the early part of the war, large concentrations of rail traffic were easily found in daylight.

Left: Para-frag bombs were dropped along the rails and roads to harass the repair crews who were housed by all major choke points. This rail bridge south of Pyongyang was hit by the 452nd Bomb Wing sometime in 1951.

The 12th Tactical Reconnaissance Squadron did an outstanding job of night reconnaissance with its RB-26Cs from Kimpo (K-14). In the background are RF-51s of the 45th TRS, another constituent squadron of the 67th TR Wing.

Below: An Invader lies wrecked on a Korean beach after a forced landing, or an overrun. Nothing more is known about this incident or the fate of the occupants other than what can be seen. Note the unbent starboard prop.

They both flew low and slow, and this put them in a very high risk category. The number of available replacement aircraft was limited. The high priority given to night-attack types did help the Invader's cause but, sooner or later, the pipeline would dry up. In the autumn of 1950, the 3rd Bomb Wing was authorised to have 24 aircraft in each of its two squadrons, but the newly arrived 452nd Wing was only allowed 16 aircraft in each of its squadrons. With six squadrons operating in combat, there was a replacement problem not only with aircraft but also with aircrews.

The B-26 combat crew training programme, located at Langley AFB, was only turning out 12 crews per month; the attrition rate for the B-26 in late January 1951 was 11 aircraft per month. At this rate, an entire bomb wing could be lost in six months. On 3 February 1951, General Stratemeyer requested the authority to increase the 452nd Bomb Wing's combat strength from 16 aircraft per squadron to 24. This was denied on the grounds that the crew training programme could not supply the manpower to sustain the additional bombers. It took a visit to the Pentagon by 3rd Bomb Wing commander, Colonel Virgil Zoller, to convince the authorities that this was necessary. As a result, steps were taken to augment the training programme, to the extent that 45 crews were graduating per month. This would produce results, beginning in May 1951.

Bomber shortfall

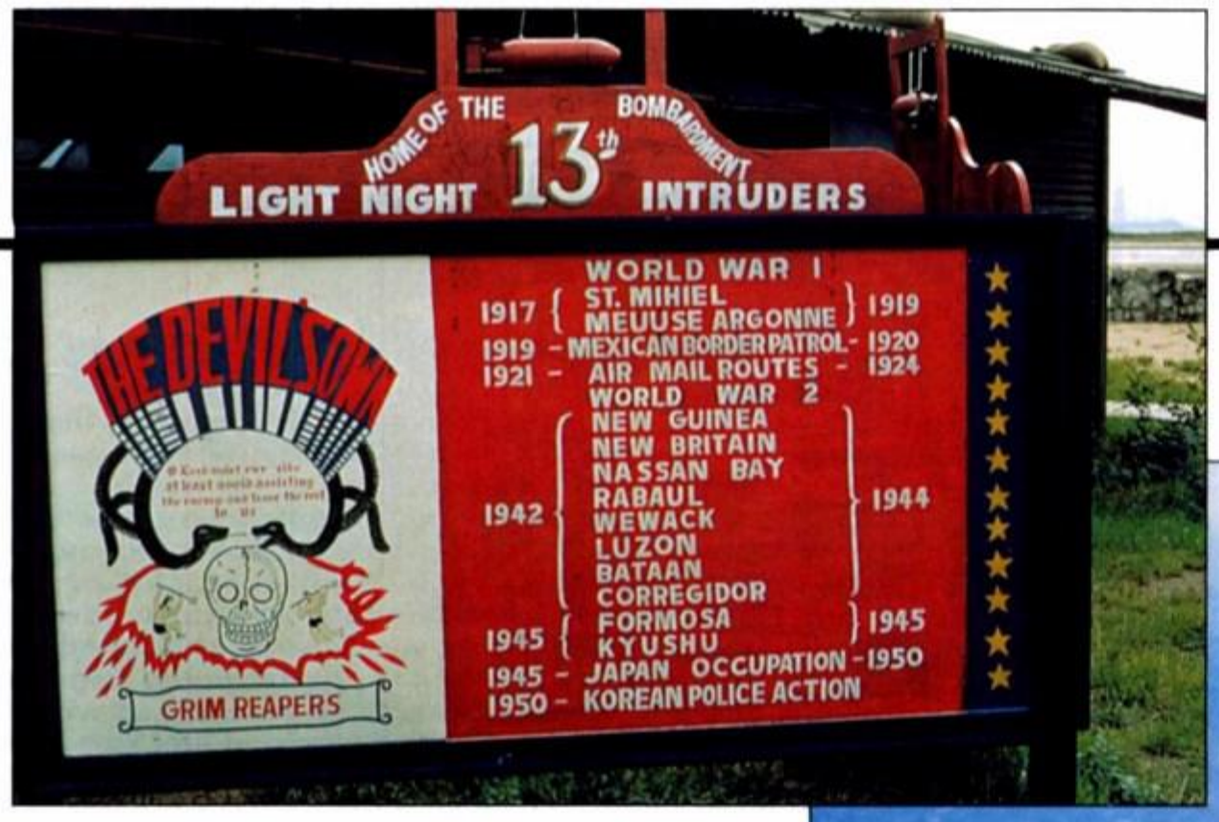
In addition to the needed aircrews, FEAF determined that they would need at least 144 front-line, combat-ready B-26s at forward bases and a reserve of at least 50 per cent, a total of 216 Invaders. Instead, they had to settle for 96 bombers and a 50 per cent reserve force. This put the entire fleet of B-26s in the Far East at 144, far short of what had been asked. At the same time these discussions were taking place, it was decided that the heir apparent to the B-26 in the USAF would be the new British B-57 jet bomber. Of course, they had to be produced and worked into inventory, and the Korean War would be over before any would see service in the Far East (June 1954).

Truck-busting was a natural for the night intruder aircrews, something at which the 3rd and 452nd Bomb Wings had become very effective. Another prey at the top of the B-26 'hit list' was trains; hunting them down was to be the most rewarding mission for B-26s crews and their Marine night-fighter counterparts. Moonlit nights provided the best hunting because the trains did not need to run with lights on, as visibility was not essential to their movement. They could also move a more substantial payload than a column of trucks. Tactics did not play as large a part in the hunt as did sheer luck. The train would usually give itself away with its smoke plume or the steam blasts shot out from the sides of the locomotive, which in cold winter weather were particularly pronounced. The trick was to catch a train in the open, drop bombs at its front and rear to stop it, and then work it over with the remainder of the ordnance – and leave it at the mercy of the early dawn attacks from the heavily armed fighter-bombers. In the mountainous terrain deep in North Korea, the trains would dart from tunnel to tunnel, making them very difficult to hit. When this happened, the Invaders would try to seal both ends of the tunnel, thus preventing the train from reaching its destination.

On moonlit nights, the bombers would drop down low and follow the moonlight reflecting from the rails. They knew that a sudden dark spot was a train. Moving sharply up and around, the bombers came in low, with their ordnance running the length of the target. On southbound trains, there were usually large secondary explosions because they were loaded with ammunition and supplies. Locomotives that were able to successfully run the gauntlet, undetected, would take several nights to make the journey to their destination. They remained in tunnels during the day.

On 25 June 1951, the 731st Bomb Squadron (night attack), attached to the 3rd Bomb Wing, was inactivated and the 90th Bomb Squadron was activated in its place. It was only a number change, and everything remained the same. The 90th would be identified by their all-black Invaders with the white trim. On 10 May 1952 the 452nd Bomb Wing was inactivated and the

This 8th BS B-26 and its crew survived a low-level night mission only to come in too low on the final approach at Kunsan. The result was nearly disaster. Note the piece of wood lodged in the aft fuselage, which fortunately was easily removable for repair or replacement.



The 13th Bomb Squadron had one of the most impressive histories of any USAF squadron. Its lineage goes back to the days of World War I. The squadron was formed on 14 June 1917 as the 13th Aero Squadron. The squadron's performance in World War II while flying the A-20 and the B-25 was legendary. This sign was posted in front of the squadron's headquarters at Kunsan in 1951. In 1957 the 13th converted to the B-57 Canberra.

Below: Returning from a night's work over North Korea in the spring of 1953, a crewman from a 17th BW Invader takes a moment to snap a picture of his flight leader. The red trim denoted aircraft of the 37th Bomb Squadron from Pusan AB (K-9).

17th Bomb Wing was activated in its place, another 'paper' change. The aircraft remained intact at Pusan East. The 728th Bomb Squadron became the 34th (green trim), the 729th Squadron became the 37th (red trim) and the 730th Squadron became the 95th (blue trim).

Switch to night operations

The year 1951 proved to be very difficult for both sides. It was the year of the MiG-15 and massive human-wave assaults by the Chinese ground forces. UN troops had their hands full on the ground and UN air forces had some extremely dangerous mission to fly, the most dangerous of all being forays into 'MiG Alley' and its industrial targets that were backed up to the Yalu River. Another equally dangerous target, that had to be hit consistently, was Pyongyang. The triple-A in these two areas equalled all the other targets put together. Daylight-flying B-29s were taking such a beating from the accurate triple-A that they would switch to night operations only.

The history of B-26 operations in Korea during the 1952-53 period could be accurately outlined within the confines of a few pages. Bases remained the same and their basic mission remained the same, but what they accomplished each and every night would fill volumes. Once the front lines stabilised, the daily task of UN air power was routine. One line of reasoning went that if the Chinese could be denied the supplies and equipment to sustain an offensive, then the war would be concluded with everything the way it had been when the war started. There was a catch to this: no-one knew just how determined Chinese logistics people were going to be, and every available B-26 and Marine night-fighter was challenged every night.

In May 1952, FEAF records reveal 187 Invaders on inventory, a mix of many configurations, each requiring much maintenance. Many of these aircraft had served during World War II and had been used heavily in post-war units. One month after these figures were released, the newly activated 17th Bomb Wing was given the responsibility of maintaining the Rear Echelon Maintenance facility (REMCO) located at Miho AB, Japan. The establishment of a rear base for each aircraft type to undergo major repairs proved to be one of the most significant decisions made during the war.

Rear-echelon repairs

When Miho AB, Japan became the primary launching pad for the 452nd Bomb Group, it was decided that all B-26s in-theatre would be sent there for major overhauls and repair of heavy combat damage. Thus, the 452nd was responsible for most of the personnel and equipment. It also did the work on all 3rd Bomb Wing Invaders and the 12th TRS's RB-26s operating under the control of the 67th Tactical Reconnaissance Wing at Kimpo. As early as the autumn of 1951, the results were outstanding. The 452nd alone raised its in-service level from a dismal 57 per cent to 82 per cent in November. By contrast, the 3rd Bomb Wing at Kunsan was attempting to do most heavy maintenance itself; its level dropped from 78 per cent to 65 per cent in short order. From then, all Invaders were brought into Miho for major work.

Initial hopes that the war would end quickly faded after many months of seemingly fruitless peace talks. 5th AF planners were determined to stop the movement of supplies to the south. The war by day appeared to be a hum-drum daily routine, with the front lines rather static, but after dark it was a rat race packed with many changes in strategy.

General Barcus, 5th AF Commander, was determined to dry up the supply routes. In December 1952, the 'truck killer' plan was initiated, calling for a large number of F-84s and F-51s to crater as many of the main roads as they could. This was done at last light, which meant that the hidden truck convoys could not get an early start until repair work had been completed. As darkness enveloped the mountain roads, the B-26s went up in strength, attacking anything that moved, missions being flown at 45-minute intervals throughout the night. This relentless nocturnal pressure was followed by the fighter-bombers coming back at first light and destroying anything left in the open. This tactic called for the use of the Mk 83 Butterfly bombs and delayed action ordnance. The Invaders would follow the fighter-bombers and drop their loads on adjacent roads that converged on major intersections. Most of this activity was concentrated on the main supply routes around Pyongyang and Wonsan.

Single B-26s flew armed reconnaissance over these areas, attacking stalled vehicles with M81 frag bombs. This tactic worked so well that sometimes as many as 25 trucks were jammed up in one area. Intelligence records show that a Chinese offensive planned for January did not

Lt Calvin Bradley congratulates his pilot, Lt Tom Tector, after another successful mission against rail traffic. Tector was one of the top locomotive killers in the 13th squadron.

13th BS navigator Captain John Thomson pauses for the camera before strapping in for another mission from Kunsan in early 1952. One of the biggest problems facing the 3rd and 452nd wings during this period was the heavy maintenance required to keep their aircraft flying. Even though all of the aircraft were less than 10 years old, they were literally worn out.

Above: Surely the least attractive of all Invaders were those fitted with the Bell IR detector, including B-26B 41-39401 in 13th BS colours (seen here). The 'Mc' tailcode arose from the 'Mac' nickname.

Left: A 'Mac' B-26 is prepared for a mission at K-8 (Kunsan) on a cold, clear February day in 1953. The gimbal mount for the infra-red unit can be clearly seen.

Infra-red Invader

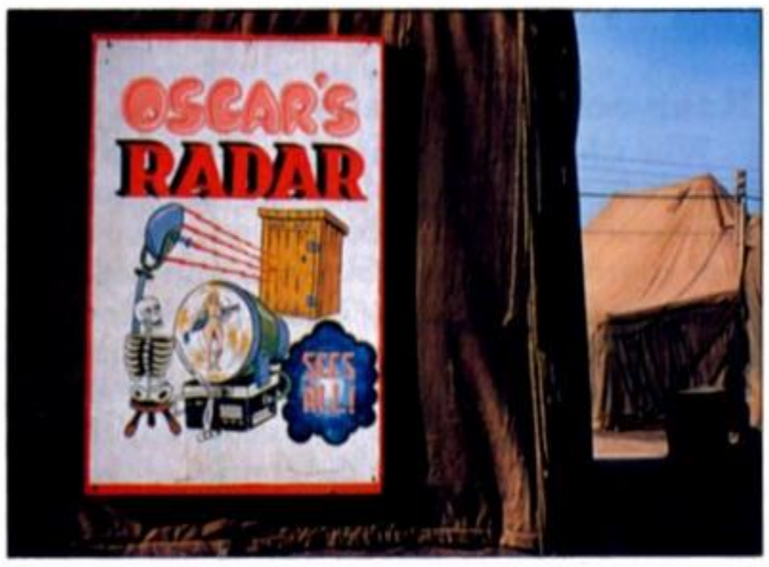
The most peculiar Invaders to operate in the Korean theatre were B-26Bs modified to carry an infra-red detector above a new bomb aimer's compartment. The equipment was called 'Mac' after a project engineer named Demetro Mac Cavitch. The IR sensor kit was built by Bell Telephone Labs and its purpose was to detect heat sources such as railroad locomotives, which were a continuing target in North Korea. The 13th BS was tasked with flying the first of the odd-looking machines under the project name Red Bird. Crews received the IR-equipped B-26 in early 1953, with nothing but a two-page booklet to tell them how to use the new system. Bell had technical representatives in the field but they left before the system was tried. Three aircraft were modified at Wright Field: *Mac's Gadget* (41-39401) was the first, another was named *Pogo*. They were flown by select crews from 3rd BW squadrons, and by at least one 17th BW unit. The technique entailed going up on a dark night and following railroad tracks. A heat source on the ground would cause spokes on a cockpit dial to spin, at which point the IR B-26 would drop a flare, providing illumination for a standard B-26 that followed. The IR aircraft would also make its own attacks. On one night alone, five locomotives were destroyed on the Wonsan-Vladivostok line, proving the feasibility of the concept.

Above: Another experimental method for night interdiction was an underwing 70-million candlepower searchlight. The device generated so much heat that it had to be turned off for five minutes for every one minute it was on. It also attracted an incredible amount of flak. The B-26 shown here was from the 8th Bomb Squadron.

Below: Standing at the rear of the bomb bay, Chester Leroy snapped this dramatic picture of an 8th Squadron B-26 salvoing its bomb load, New Year's Eve 1952. The bombardier has aimed the bombs through the break in the overcast seen at the top of the frame.

materialise due to the lack of sufficient food and ammunition. Confirmed figures for the first full month showed that 3,139 vehicles were destroyed. This included any that were left exposed and were credited to the daytime fighter-bombers. During the summer of 1952, most months produced far fewer than 2,000 destroyed.

For the first few months of 1953, the Chinese made a major effort to build up what they needed for a major spring offensive. The peace talks were making progress and the war could end on very short notice, and everyone – Chinese and HQ FEAF – knew that the position of the front lines at the time of the cease-fire would mark the border between north and south. There could be no let-up on the pressure put on the Communist logistics network, and the workload of the 3rd and 17th Bomb Wings became almost impossible to sustain. The key factor in this situation was that Marine night-fighter squadron VMF(N)-513, which had flown the F7F Tigercat and F4U-5N, had completely converted to the F3D. Their mission no longer supported the night intruder tasking, and it was all left to the Invader squadrons.



There was no shortage of local artistic talent to whip up a unit sign when needed. This sign at Kunsan was typical and may have alluded to the 'Red Bird' Invader project at the base.

Right: This view of a 90th Bomb Squadron B-26C shows the squadron's distinctive white trim to good effect. The 90th was the third of three squadrons flying with the 3rd Bomb Wing's colours from Kunsan in October 1952. Bombsight-equipped B-26Cs were used as formation leaders for daylight medium-level missions as well as night attacks.

As the days of July counted down to the ceasefire, all components of the UN Air Arm were working overtime. The B-26 mission shifted somewhat to flying close support of the troops on the front lines; 43 per cent of sorties flown by Invaders in July were of this type. They did not abandon the interdiction tasking along the main supply routes, however. The 3rd and 17th Wings flew a total of 452 night intruder sorties in July, claiming 1,379 enemy vehicles destroyed. The massive efforts by the Chinese ground forces to gain more ground before the war ended resulted in casualties of at least 72,000 troops. This equated to nine divisions lost.

The last mission

During the final minutes of the war, it was the Douglas Invader in the spotlight. The final bombing mission of the war was flown by an 8th Bomb Squadron B-26C piloted by Lieutenant Donald Mansfield. The last military aircraft to fly across the bomb line, just minutes after Mansfield landed, was an RB-26C from the 12th Tactical Reconnaissance Squadron.

Lt Robert Swanson, Pilot, 8th BS

"It was 15 March 1953 and our mission was to search out and destroy any truck traffic moving south. We took off from Kunsan right on time and about half-way to our patrol area, I called the B-26 that would be coming outbound, TATOO 91. He gave us a weather update for the area and stated that it was the darkest night he had flown in so far, and he was right. The mountains were almost invisible, which made any low attacks extremely dangerous.

"We were able to drop down into some of the valleys using our instruments. There wasn't much activity on the roads, but we kept an eye open for any sign of lights or movement. Toward the end of our shift, we caught a sizeable convoy on the move. I dropped a flare to give us enough light to find the rear end of the column. I came in at a steep angle with my guns firing all the way. As I came over the trucks that were bringing up the rear, I unleashed my fire bombs. The second pass really made some good hits before I climbed back up to 3,000 ft.

"As I came down for another pass, everything was going too well! The trucks were trapped on a narrow road, so they could not disperse into the trees ... they were sitting ducks. I had hit all but about six of the trucks and was lining them up for a final pass. I was banking in a low left turn and, out of the corner of my eye, I spotted something move. It was my good luck charm swinging from one of my gauges. In the split second it had taken me to focus on the movement, I had overshot my turning point. Although I pressed off about 30 rounds, they were wide of the mark. As I racked my Invader up on its wingtip, a stream of quad-50s roared up past my left wing. It had been the closest call I've ever had.

"If I had not pulled up 'provoked' over missing my turning point, we would all now be dead! I have nothing but admiration for the cool, brave gunner who had waited for me as I progressed down the convoy. He was a very patient man! Still ... we had a job to finish. Knowing what was waiting for us down there made it a little more difficult. I went down low for one high-speed pass. My gunner tracked the column of remaining trucks and sprayed them with 50-calibre fire from one end to the other. The quad-50s fired on us with almost perfect tracking, but he was a little behind us. On the way back to base, I realised that if it had not been for the movement of my good luck charm, we would have been shot down!"

Robert Swanson stands by his B-26B, named after a girl he knew at the University of Denver.* Miss Jacque *was assigned to the 8th Bomb Squadron during the early months of 1953. The war was winding down, but the pressure put on the B-26 squadrons was greater than ever.

The war in Korea ended on 27 July 1953, 37 months after it had begun. FEAF had developed into a major force, starting out with 33,625 personnel in June 1950 and ending with over 112,000 in the summer of 1953. At its peak, it controlled 69 squadrons with an inventory of 1,536 aircraft. This impressive organisation was responsible for flying almost 721,000 sorties. Of this total, 192,581 were interdiction and 57,665 were close support (these figures were compiled by the USAF Historical Branch and do not include Marine and Navy statistics). Of this total, the Douglas B-26 Invader and its aircrews had a large share ... and what makes it so impressive is that they flew a large percentage of them at night. The 3rd, 17th and 452nd Bomb Wings were definitely heavy contributors in halting the spread of Communism on the Korean Peninsula.

Warren E. Thompson

Above: An 8th BS Invader gets a check ride after some maintenance work at Kunsan just days before the war ended. All of the B-26s in theatre were kept busy during the final few days in an effort to keep the Chinese from launching an offensive to gain more ground.

Above: On 27 July 1953, the 8th Bomb Squadron flew the final bomb sortie of the Korean War. This was the crew who flew it, in B-26C* Bye Bye Bluebird *(left to right): 1st Lt Bill Ralston (B/N), A2C Dennis Judd (gunner) and pilot 1st Lt Don Mansfield.

Below: It was late summer of 1953 and the war had just ended. Nonetheless, the 3rd Bomb Wing kept its aircraft and aircrews combat ready. This Invader – Wildcat Willie of the 13th squadron – is seen on a daytime practice mission over the Sea of Japan.

Lockheed F-94 Variants

The F-94 can boast many achievements. It was the first jet-powered interceptor in Air Defense Command (ADC), and the only one for more than three years. The powerful F-94C was the first two-seat aircraft to fly faster than sound. It was also the first production fighter to be equipped with all-rocket armament and the first to use a drag 'chute to reduce landing roll.

The 15th production Starfire, 50-970, poses for one of a series of publicity photographs. This aircraft was delivered to the Air Proving Ground Command at Eglin AFB on 3 October 1952 where it was used as a test aircraft in the programme to develop wing rocket pods for the F-94C.

It was a well-liked warplane that performed an important mission in which everyone believed, but, like most aircraft of the early jet era, the F-94 was beset with teething troubles. The F-94C Starfire was initially so handicapped by its engine that the USAF considered cancelling it; the Hughes fire control system on the F-94C was also trouble-plagued until an enormous effort went to fixing it. In the end, the F-94 could never overcome the basic deficiency inherent in its design: it lacked range. As the ultimate development of a relatively small aircraft dating back to 1943, the XP-80, the F-94 never had the internal volume to permit greater fuel capacity.

First deliveries

The USAF took delivery of its first F-94A in December 1949. Initially, F-94As were assigned to the 317th Fighter Interceptor Squadron at McChord AFB, Washington and the 319th FIS at Moses Lake AFB, Washington in May 1950, replacing the North American F-82G Twin Mustang. At the time, the defence of the United States was in the hands of CONAC (Continental Air Command). The mission reverted soon afterward to ADC (Air Defense Command). More than three years were to elapse before other all-weather interceptors, the F-86D Sabre and the F-89 Scorpion, joined the Lockheed fighter in the American air defence inventory.

The improved F-94B began to reach the 61st FIS at Selfridge AFB, Michigan in April 1951. As was typical for that period, men defending North America against a Soviet attack received priority over those who were bleeding and dying in Korea. Perhaps rightly – and many veterans believe this today – it was more important to guard New York than to shoot down a MiG over the Yalu River. ADC, along with SAC (Strategic Air Command), seemed to enjoy an absolute priority for everything, from an F-86A Sabre day-fighter (very numerous in air defence squadrons before there were enough in Korea) to the new airfield at Thule, Greenland built in 1952. F-94Bs were regularly arriving at Stateside bases before the first contingent of F-94As and Bs went overseas to the war zone.

The 339th FIS, which had flown F-82 Twin Mustangs in combat during the first weeks of the Korean War, took delivery of its first two F-94B fighters on 6 April 1951 at Johnson Air Base, Japan. Ten more had arrived by the end of the month. This squadron apparently never made the move across a narrow strait to the Korean peninsula, perhaps because the defence of Japan also took high priority. It did achieve what might be considered the first 'kill' by an F-94 when it shot down a C-119 Flying Boxcar transport.

Boxcar kill

On 24 May 1951 Captain George Blank took off in a C-119 from Tachikawa Air Base near Tokyo with a crew of three and two US Army passengers, with a load of ammunition and an ice cream freezer. Shortly after take-off, the Flying Boxcar began shuddering so badly that the crew thought the engines were about to fall off. Blank headed out to sea, ordered the crew and passengers to bail out, and went out the door behind them. All six men landed in rice paddies without injury or difficulty. After

Prototype 48-356 began life as just another production P-80C, but finished up with eight other designations during its career as Lockheed's prototype for most of the P-80/T-33/ F-94 variants. Here it is seen configured as the YF-94/F-94A prototype.

F-94B-1-LOs from the batch ordered during the 1950 fiscal year undergo final preparations for flight test and delivery from Van Nuys Airport, then the home of Lockheed's production jet aircraft flight test centre.

they had bailed out the aircraft, which came to be known in Combat Cargo Command as 'The Flying Dutchman', turned around of its own accord and headed back toward Tokyo.

Before he jumped, Blank radioed Tachikawa of his intentions. A request was sent to Johnson Air Base for fighters to follow the aircraft out to sea and shoot it down when it was over the water. A pair of F-94Bs was sent up. They intercepted the C-119 and followed it while looking for an opportunity to shoot it down when it was over an unpopulated area. The two fighter pilots reported that the aircraft seemed to be flying okay, and suggested they wait until it flew into a mountainous region north of Tokyo. Although they fully expected to see it crash into a mountain, the stubborn C-119 cleared the peaks and continued on. For two and a half hours they followed the pilotless aircraft, until it finally crossed the coast into the Sea of Japan near Niigata. After "many shots" the C-119 finally caught fire, exploded and crashed into the ocean. Thus, the errant C-119 Flying Boxcar was the first F-94 kill of the Korean War. Ironically, in Stateside ADC jargon, 'Boxcar' was the codeword used by GCI (ground control intercept) controllers to signify a large bomber.

Korean interlude

The 68th FIS 'Lightning Lancers' at Itazuke Air Base, Japan began to receive F-94As on 10 October 1951. The arrival of this new combat aircraft with a profile almost identical to the T-33 trainer was celebrated in the popular 'Terry and the Pirates' comic strip by George Wunder, which had a Communist agent trying to figure out why the nose, with its radar, was different from that of the trainer.

With or without help from the cartoonist or the 'Terry' cartoon's radar operator named Hot Shot Charlie, FEAF (Far East Air Forces) clamped an extraordinary restriction on F-94 operations. Commander of the 68th Major Donald E. McNeil took a pair of F-94As to K-13 Suwon Air Base to stand alert beginning 28 December 1951, only to be given firm orders that he was prohibited from flying the F-94 north of the bomb line. During the day, MiG-15s were wreaking havoc with the Allied air forces; they had wiped out no fewer than six B-29 Superfortresses in one day in October, counting aircraft which brought their crews home but never flew again. This caused FEAF to shift most B-29 sorties to the nocturnal hours, when night intruders dubbed 'Bedcheck Charlie' were causing chaos at American air bases. Some MiGs and possibly Yak-15s were also operating at night. Yet, FEAF was more worried about the F-94's precious new radar falling into enemy hands than about Americans being killed and wounded because the F-94 force was shackled.

The F-94A appeared only briefly in Korea, and the 68th soon converted to the B. The 319th FIS re-equipped with the newer F-94B as well and began operating from Suwon on 22 March 1952, still under orders not to fly over enemy territory, to prevent compromising their secret electronic equipment. The FEAF order merely repeated a policy established by the Air Staff in the Pentagon, who had decided that the radar and fire control system was too valuable to risk. Neither the top brass nor Soviet agents, if there were any around, seemed to grasp the essential reality about the radar: it was unreliable and cantankerous and was, in the words of one technician assigned to keep it running, "so finicky that it will break down if you look at it the wrong way." Many early problems were solved with practice and repetition, and with a tremendous support effort by Hughes, but an F-94 crew always taxied out from the revetment not knowing whether the radar would continue to work for an entire flight.

Even while constrained, F-94 crews and those who supported the mission created tactics that were to become more or less universal. Kept on alert with a crew already strapped in (or, at Stateside bases, within a few feet of the aircraft), an F-94 would 'scramble' when an unidentified aircraft (or bogey) was detected by ground-based radar. In Korea, this meant any bogey that looked like a threat; at Stateside ADC bases, it meant any unidentified aircraft entering a coastal ADIZ (Air Defence Identification Zone). Contrary to Hollywood myth, ADC interceptors did not routinely intercept aircraft over the Grand Canyon or downtown Detroit, and were not expected to.

Under the Korean model for these tactics, when a bogey was suspected of being hostile, the GCI operator gave voice radio instructions to the climbing F-94 and positioned the fighter for identification, usually from the starboard side of the suspect or down-moon on moonlit nights. At altitudes above 20,000 ft (6096 m), the best approach was to come in 1,000 ft (304 m) below the bogey while range still exceeded 2 miles (3 km). This enabled the F-94 to close to a slow pace until a positive identification could be made. If the intruder was too distant or flying quickly, the F-94 would be able to close only on afterburner, eating up precious fuel and potentially surrendering the element of

Based at Great Falls (later Malmstrom) AFB, Montana, the 29th FIS was the only USAF squadron to fly the F-94C from the 'Northern Tier' states. These three aircraft, with Dayglo Arctic tail markings, were photographed in the mid-1950s, possibly during a gunnery meet: their missing rocket pod nosecones suggest that their FFARs have been fired.

Left: The first production F-94A, 49-2479, displays the original underslung fuel tanks fitted to this model. They were later replaced by Fletcher centre-mounted tanks.

Below: Aircrew of the 449th FIS stand by their F-94As at Ladd AFB, Alaska, ready to scramble and intercept unidentified aircraft reported by AEW radar in the north of the state. Eventually, F-94 units applied squadron badges to their aircraft, often displacing the buzz number on the nose to a position on the fuselage, as seen on the nearest of these two aircraft.

surprise. In time, veteran crews in Korea could identify a hostile aircraft (usually a Po-2, Yak-18 or La-9) by its exhaust pattern.

Once committed to engage, the F-94 attacked from the front quarter when time and relative position permitted. In the Korean scenario, if time permitted, the pilot was expected to challenge the GCI controller using FECTEC (Far East Command Technical) voice authentication procedure. Both sides were listening to each other (one of the keys to identifying an intruder in the first place) and without authentication it was theoretically possible for an enemy radio operator to order a 'kill' of a 'friendly'. Authentication was accomplished using a one-time code carried on a placard by the F-94 crew and duplicated at the GCI centre.

When an intruder was known from the beginning to be hostile, both in Korea and in ADC squadrons, much of the preparatory effort was dispensed with.

Restrictions lifted

The restriction on use of the F-94 was lifted in January 1953, following a visit to Korea by USAF chief of staff General Hoyt S. Vandenberg. The 319th FIS began flying protective patrols 30 miles (50 km) ahead of B-29 formations. On the night of 30 January 1952, an F-94B flown by pilot Captain Benjamin L. Fithian and radar operator Lieutenant R. S. 'Sam' Lyons was launched against an intruding Lavochkin La-9 piston-engined fighter, which was never seen by the friendlies but was apparently identified via a communications intercept. After another F-94 radioed "no joy," meaning that his RO (radar observer) could not establish contact using the interceptor's onboard radar, Fithian and Lyons made radar contact, extended air brakes to stay behind the slower Lavochkin, and attacked, firing using the radar scope. Fithian did not see his opponent until his machine-gun rounds set the La-9 afire and sent it spinning into the sea with the canopy closed. It was apparently the first aerial victory in history against an opponent who was never seen during the engagement.

On 10 May 1953, an F-94 in the hands of pilot Captain John R. Phillips and radar

By 1949, the 449th Fighter Squadron (All-Weather), equipped with F-82H Twin Mustangs, provided Alaska's only tactical all-weather capability. Alaskan Air Command received its first F-94As in August 1950, the 449th FIS (as it was now designated) doubling in size as the new aircraft supplemented its F-82s. Here, four of the unit's new F-94A-5-LOs are seen sporting the Dayglo tails applied to aid conspicuity in the event of a crash in the icy north.

Caught in the barrier at K-13 (Suwon) in late 1953 was F-94B 51-5355 of 'Red Flight', 319th FIS. The aircraft had earlier served with 'Yellow Flight' of the 68th FIS, also at Suwon.

Right: Bereft of any form of unit markings, this newly delivered 339th FIS F-94B taxis past hangars at Johnson AB, Japan in early 1951. In the background a C-47, a T-7 and several T-6s may be seen.

operator Lieutenant Billy J. Atto shot down the first MiG-15 to fall to the Lockheed interceptor. Before the war ended in July, Korean-based F-94Bs shot down two more nocturnal intruders. On 3 May 1953, an F-94B crewed by First Lieutenants Stanton G. Wilcox and Irwin L. Goldberg throttled down to 110 mph (177 km/h) to attempt a low-level kill of a Polikarpov Po-2 biplane, and crashed into terrain. Both men lost their lives. On 12 June, Lieutenant Colonel Robert V. McHale, commander of the 319th FIS and his back-seater Captain Samuel Hoster were killed when they apparently collided with a Po-2 they were attempting to intercept.

Apart from early maintenance snags with the radar, the F-94A/B was generally a reliable aircraft, even under combat conditions, but was too lightly armed and was deemed unlikely to be effective against modern bombers in defending the North American continent. The USAF wanted an interceptor with greater rate of climb, more range, and heavier firepower.

Right: A 'finger four' of 339th FIS F-94Bs banks away from the photographer during a training mission over Japan, shortly after the unit traded its F-82s for the new jet fighters in 1951.

Its afterburner producing a long finger of flame, a 319th FIS F-94B-15-LO undergoes engine runs in the PSP-covered dispersal at Suwon (K-13) prior to a 'Bedcheck Charlie' mission in July 1953. As one of the first and therefore most experienced operators of the F-94A, the 319th was one of the first F-94 units committed to the Korean police action. By the time the unit had arrived in Korea, it had re-equipped with F-94Bs.

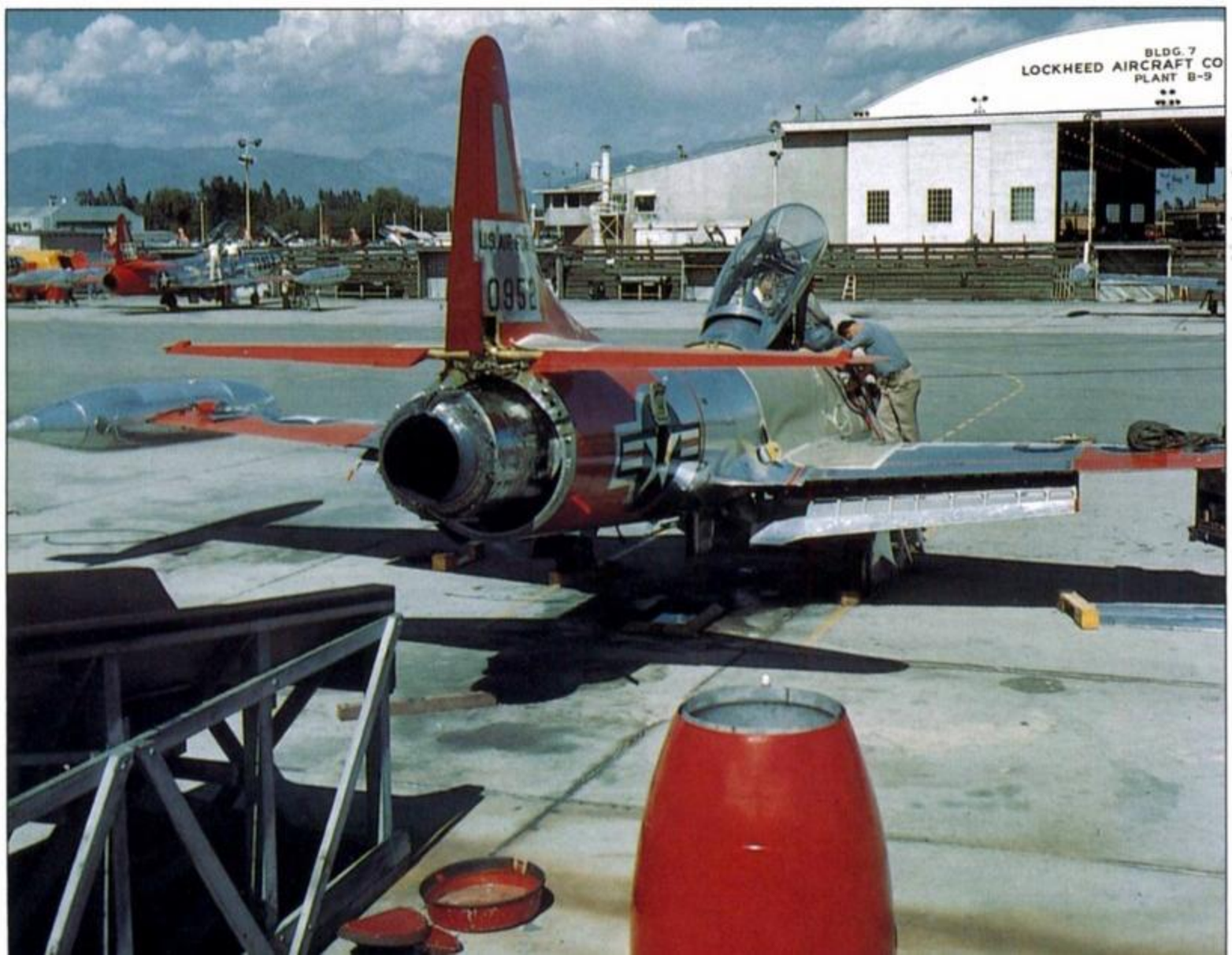
Left: In late 1952, a detachment of the 59th FIS left its base at Otis AFB, Massachusetts for Thule AB, Greenland. Thule was just 900 miles (1448 km) from the North Pole and was established as a SAC base for B-47s. The rest of the squadron moved to Goose Bay, Newfoundland, Canada as the first fighter squadron assigned to North East Air Command. Here, pilot 1st Lt Lee Grude and RO 1st Lt Tom Woit fly 59th FIS F-94B 50-885 on a mission from Goose Bay.

Below left: Shark-mouths were not a common sight on F-94s, but those of the 61st FIS at Selfridge AFB, Michigan were well-known.

*Above: **PFFHT** was F-94B 51-5323 of the 136th FIS, New York ANG, which picked up Bs in February 1954, mainly from Alaska's 449th FIS, operating them for four and a half years.*

Above: After war broke out in Korea, Alaskan Air Command's 57th FIG followed the 449th FIS in re-equipping with F-94Bs, in 1951. 51-5493 of the 64th FIS, 57th FIG was originally delivered in January 1952, only to be lost in an accident at Elmendorf AFB, Alaska on 10 September.

Below: F-94B 50-952 at Lockheed's Plant B-9 at Burbank in the USAF's Arctic paint scheme is prepared for delivery to Alaska, where it was eventually lost on 6 October 1952.



The rocket-armed F-94C was introduced and publicists dubbed it the Starfire, following a Lockheed tradition of nicknames with heavenly connotations. The C model, the only variant in this series ever to be named Starfire, encountered early developmental problems, many of which centred around the unreliability of its E-5 fire control system. In addition, early F-94Cs had a leaking canopy seal which caused electrical short circuits. Initially, the F-94C had a distressing tendency to flame out when its nose rockets were fired, a problem which was resolved with minor changes in the contour of the nose. The F-94C was two years behind expectations when it began operational flying with the 437th FIS at Otis AFB, Massachusetts on 7 March 1953.

During a test flight evaluating the structure of the aircraft in a dive, the F-94C became the world's first two-seat aircraft to exceed the speed of sound. Diving from 45,000 ft (13716 m) with afterburner, Herman 'Fish' Salmon was near the pull-out point when the Starfire passed Mach 1.0. Later, operational F-94C interceptors routinely flew supersonic in a more shallow dive.

Good and grim

Life in an F-94 squadron was a mix of the good and the grim, all of which looks better nearly half a century later. At the F-94C Starfire-equipped 60th FIS at Otis AFB the commander was Lieutenant Colonel Daniel 'Chappie' James, the black American veteran of World War II and Korea who later rose to four-star rank and commanded ADC. The operations officer was Navy exchange officer Lieutenant Commander Thomas Hudner, who had been awarded the Medal of Honor for an attempted rescue of a fellow F4U Corsair pilot in Korea. First Lieutenant Jim McNicholas joined the squadron from flying school in June 1956. "Most of our pilots and ROs were unmarried. Some of us rented a four-bedroom house on New Silver Beach. We called it the 'Auger Inn'. It came with a 25-ft Arrowhead sloop and a private mooring, to go with our

Lockheed F-94C-1-LO Starfire 46th FIS 4710th ADW Dover AFB 1954

Powerplant
With the Starfire came an entirely new engine, the 8,750-lb (38.92-kN) Pratt & Whitney J48-P-5, a development of the Rolls-Royce Tay turbojet (built by P&W as the J42), giving 30 per cent more thrust than the afterburning Allison J33 (as fitted to the F-94A and B). Warping and cracking of the J48's afterburner caused early problems, followed by fuel burner nozzle failures which led to the type's grounding during 1952. A tendency to flame-out above 25,000 ft (7620 m) if all 24 nose rockets were fired at once also presented difficulties. Though the engine's overall performance was good, the USAF sought to improve climb rate and high-altitude reliability and considered re-engining the F-94C fleet with the J48-P-8, but installation problems led to the project's abandonment.

Production and costs
Considering the F-94C had such a short service life, the $1,068,246 'fly-away' price paid for each aircraft was not an inconsiderable sum. This was broken down as follows: airframe $534,073, engine (installed) $90,147, electronics $7,058, ordnance $518 and armament $55,595.

Markings
Typically, ADC F-94Cs were turned out in natural metal, with large buzz numbers applied to the nose. Often, elaborate and colourful markings were applied by squadrons. 113600 has the 46th FIS emblem (officially, "a black sabre-tooth tiger passant in front of a horizontal bank of white clouds") applied to the fuselage, behind the cockpit.

51-13600
F-94C-1-LO 51-13600 was the fourth-to-last Starfire built and upon joining the 46th FIS, became the mount of the unit's commanding officer, Colonel William O'Donnell. The 'FA' buzz number code was originally assigned to the Beech F-2 Expeditor photo-reconnaissance type, but after 1948 became a fighter code and was applied to surviving Lockheed F-38 Lightnings. Upon disestablishment in 1958, half of the 46th's Starfires were flown into storage and eventual disposal at Davis-Monthan AFB, while the rest were split between other units still operating the type.

Rocket armament
Controlled by the Hughes E-5 fire control system (FCS), the Starfire's weapon system represented a radical departure from that of the F-94B. The system's radar presented an image to the RO and simply required the pilot to steer the aircraft in the direction of the target for a so-called 'collision-course' interception using 2.75-in (6.99-cm) Folding-Fin Aircraft Rockets (FFARs). Twenty-four were carried, six each in four compartments arranged around the radome, and from the 100th aircraft another 12 were carried in a pod on each wing.

46th Fighter Interceptor Squadron
Reformed on 1 November 1952 as part of the 4710th Defense (later Air Defense) Wing, ADC at Dover AFB, Delaware, the 46th FIS took over the F-94Bs of the 148th FIS, a Pennsylvania ANG unit called to active duty in February 1951, during the Korean War call-up. The 46th's B models were replaced by F-94Cs in May 1953, these aircraft providing air defence for the mid-Atlantic states for the next five years. On 1 March 1956 it was reassigned to the 4709th ADW and then on 1 October to the 4621st ADW (later New York Air Defense Sector). Its final assignment took place on 8 February 1957, when it joined the 4728th Air Defense Group, in which it remained until 1 July 1958, when it was once again disestablished.

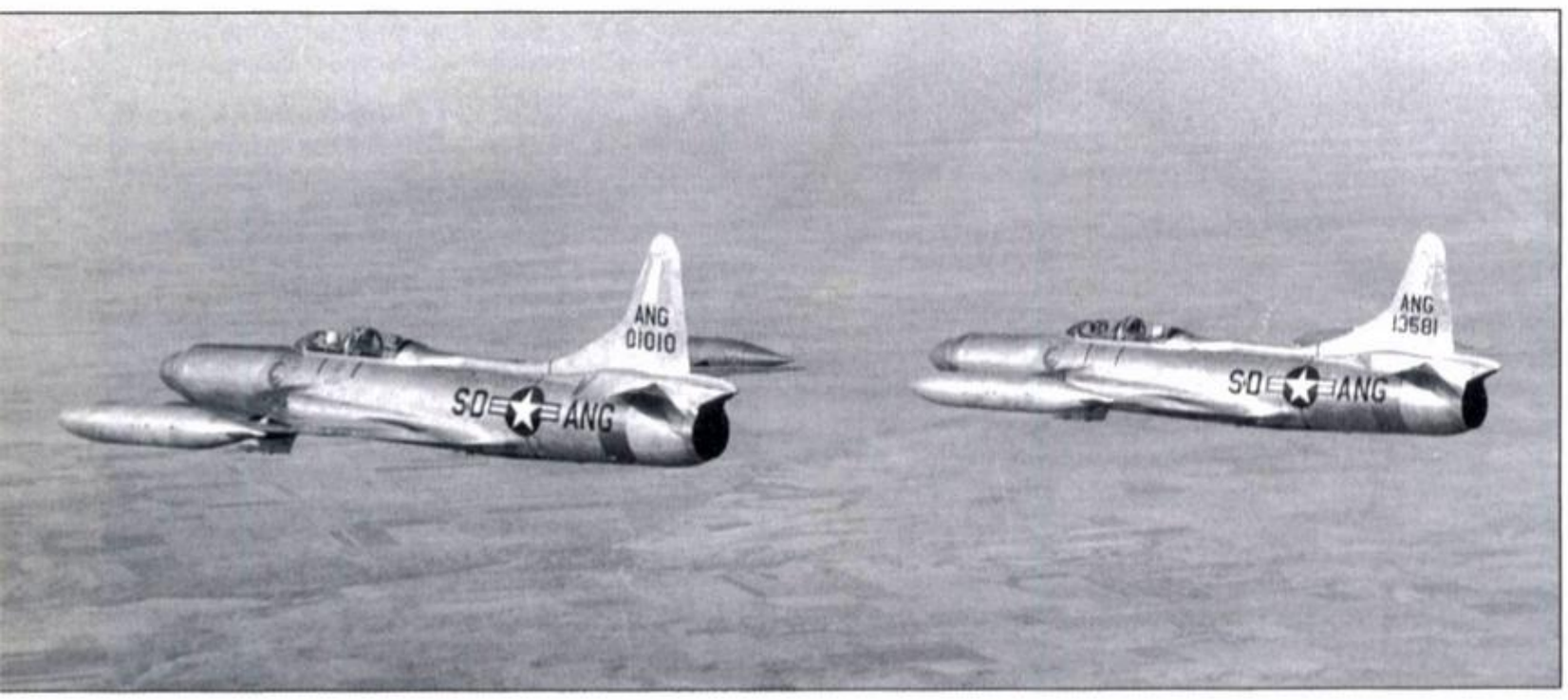
Amidst a sea of T-33s on a clear California day, two F-94Cs await delivery from Plant B-9 at Burbank in February 1954. 51-13538 and 51-13540 were both destined for the 3550th Training Wing at Moody AFB, Georgia. Other Starfires may be seen under cover in front of Building 7 in the background, including 51-13544. Note that these late-production aircraft had wing FFAR pods fitted from new.

Stinson 10A tied down at Coonamesset Airport. We would invite ladies on weekends and play golf and have great parties."

In the cockpit of an F-94, life remained very serious. On a night of "rain-lashed gusts," as James H. Winchester wrote about an F-94 intercept mission in *True* magazine, the voice of a radar operator in the F-94's back seat "blatted mechanically on the intercom, muffled by the oxygen mask that gripped his face." "He was sweating uncomfortably under three layers of flying clothes. Jack-knifed into the bulk of his parachute pack, he was wedged in cramped confinement. He peered intently into a black box that held a pendulum-thread of green light and a faint green speck.

"The man in the front seat, holding the control stick, gazed through Plexiglas into the thick blackness of overcast night. In the featureless space around him, there was nothing – a cold void forever alien to human life."

This was not a bad account of how it felt to head up to intercept a bogey in darkness and rain. The F-94 was generally well-loved (although early models were especially cramped, and the cockpit had to be widened to enhance prospects of survival in an ejection), but flying on radar at night, often against an unknown adversary, was dicey. Not as dicey as an instrument let-down in bad weather, especially in the inadequately-equipped A model, but even under the best of circumstances it was a difficult kind of flying.



Above: The 175th FIS, South Dakota ANG operated its first F-94As and Bs in June 1954, when they replaced F-51D Mustangs. Starfires (pictured) followed in May 1956, serving until January 1958, when F-89Ds arrived. F-94s were first assigned to the ANG during the Korean War, when three squadrons were on active duty with Air Defense Command. The F-94A and B entered service with the Guard again in 1953, the last F-94Cs being retired in July 1959, by Minnesota's 179th FIS.

Right: Examples of the USAF's all-weather fighter types of the mid-1950s are seen here at Hughes's Culver City flight test centre. The F-86D Sabre, F-94C Starfire and F-89D Scorpion employed first-generation fire control systems, of Hughes types E-4, E-5 and E-6, respectively.

F-94Cs come together on the production line at Lockheed's Burbank plant. In the background, wings, complete with main landing gear doors, are being assembled on jigs, prior to being mated to the forward fuselage sections to the right.

"Flying nine miles a minute, they heard no sound except whispered hums and clicks and hissing of small auxiliary devices as the plane's turbojet powerplant flung its intolerable howl behind them. They were hunters equipped with an electric sixth sense." To fly the F-94 at all, crews had learned a whole new vocabulary in order to follow instructions from the ground GCI controller. "Go to gate", for example, was an instruction to apply afterburner. A 'vector' was a bearing on an approaching intruder.

Temperamental radar

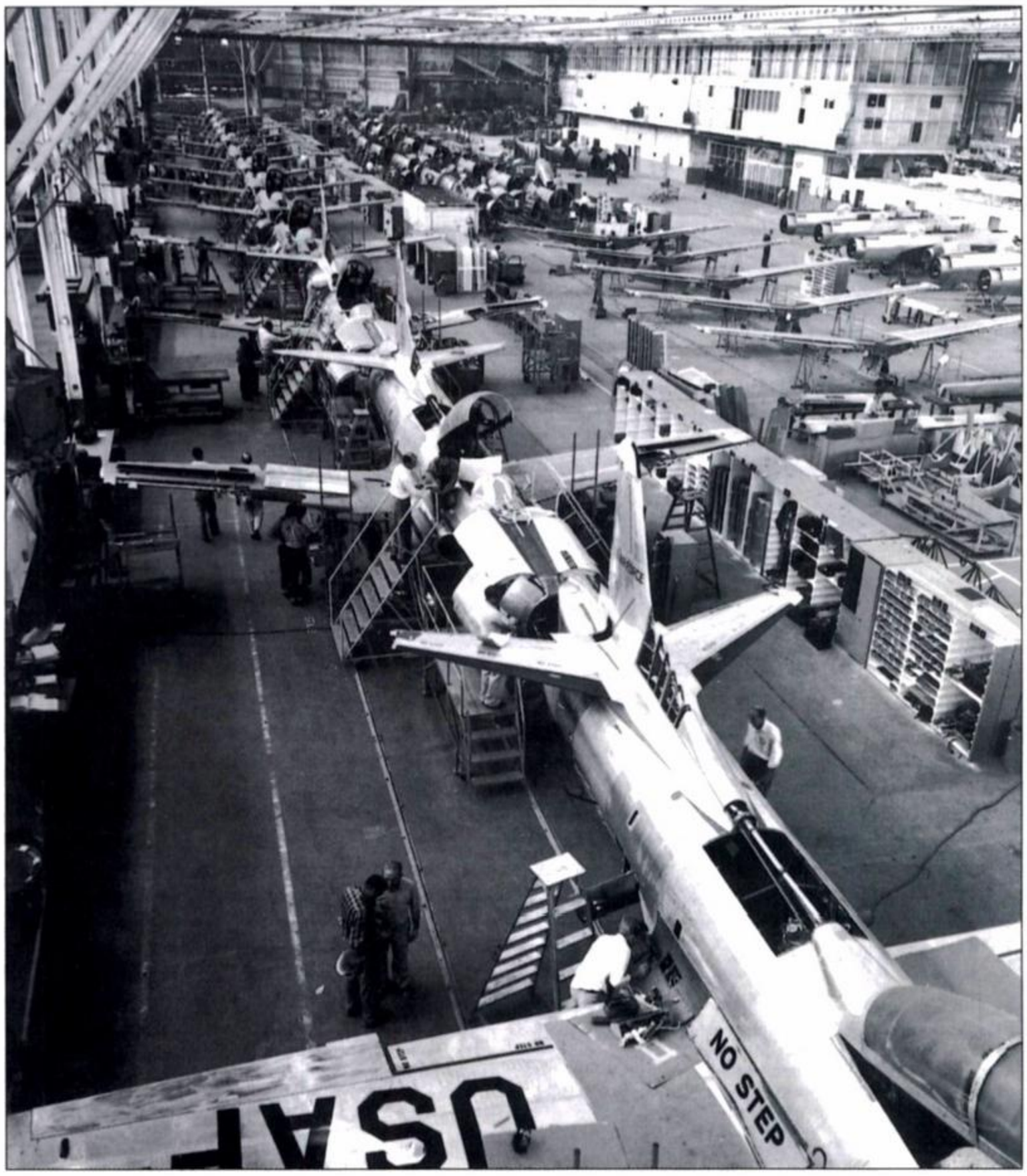
The onboard Hughes radar did not always work, and when it did work it needed to be within about 20,000 yd (18288 m) of the intruder. The RO would announce, "I have joy" when he detected the adversary on his scope, which was hashmarked to provide an accurately scaled reading of distance, direction and elevation, unlike the pilot's much smaller scope which was intended to direct a firing pass at close range.

At about 1,000 ft (304 m) from the target and still not able to see it with the naked eye, the pilot would look into the 4-in (10-cm) scope in the middle of his instrument panel. A wide circle represented the range to the target, a ¼-in (6.4-mm) circle the target, and a dot the F-94. "It's like that kid's game where you'd try to put a BB into a hole," remembers Al Perry, a pilot in the 59th FIS. "In theory, if the two circles and the dot merged, you'd be flying into the target" – something F-94 crews contemplated in the event of real war. In a combat situation, F-94 crews expected to fight intruders without ever seeing them. Only in a scramble against an unknown that turned out not to be hostile would they usually reach the point of visual observation.

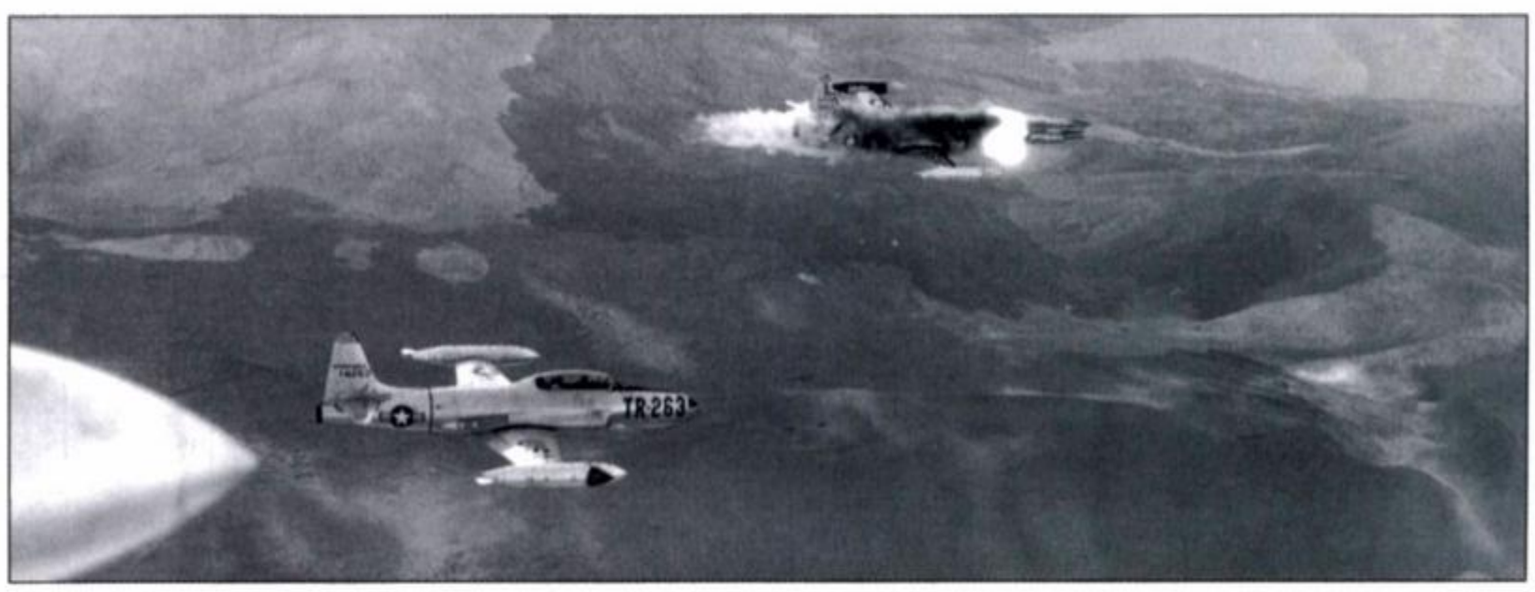
'Judy' was the radio term signalling that the F-94 crew was taking over on its own from the GCI director. 'Tallyho' meant a visual sighting of the target. An intruder could be a 'Boxcar' (heavy bomber), an 'Eagle' (medium bomber), or a 'Rat' (enemy fighter). If known to be hostile, it was a 'bandit'. In 1956, the US adopted the Air Standards Co-ordinating Committee (ASCC) nicknames for Soviet aircraft. Pilots and ROs took recognition training to identify aircraft that were now called 'Bulls', 'Badgers' and 'Bisons'. The nicknames were a NATO standard but most were invented in the United States.

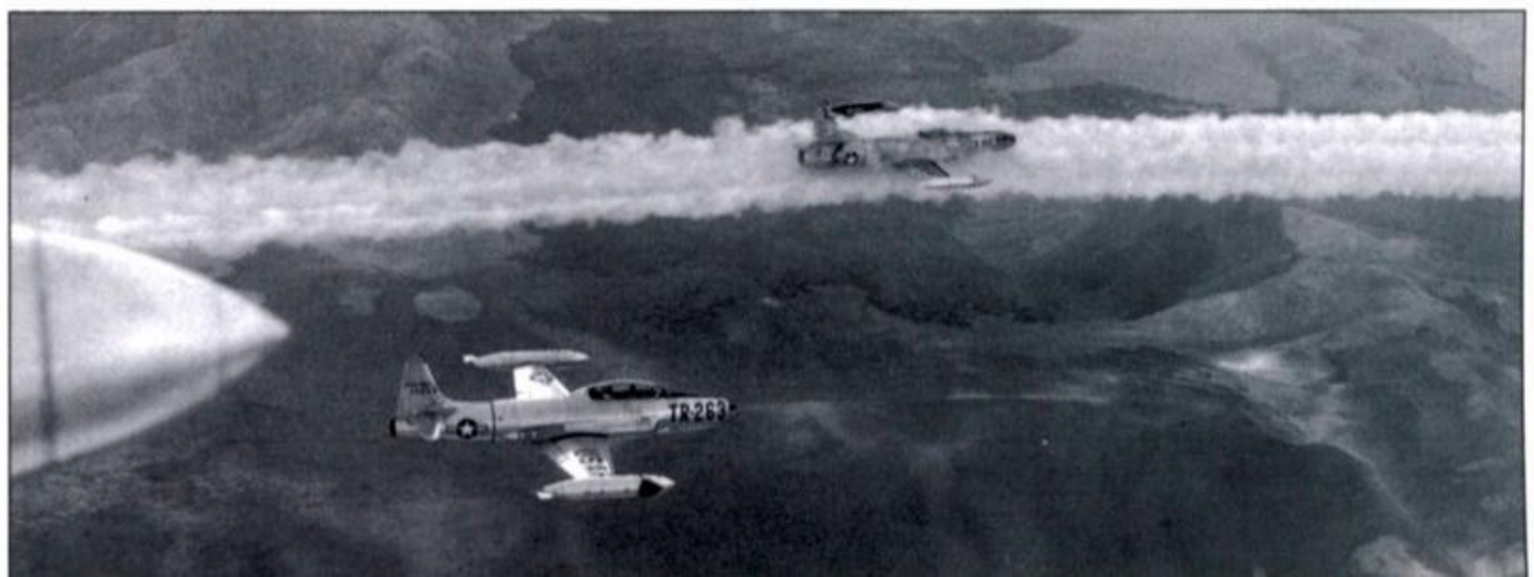
"The RO had an Aldis Lamp," remembers Perry, "a narrow-beam floodlight. He used an eyepiece to aim it, the way you aim a rifle. The pilot would give him instructions while reading the scope, something like '45° up starboard.' If it was an airliner, the lamp would scare the hell out of the aircraft crew and the passengers." The F-94 pilot would read off the registry number painted on the tail of the intruder. "If it turned out to be an aircraft that hadn't filed a flight plan, they might scramble more fighters."

F-94 crews trained and flew in the grim certainty that a lone bomber with a single atomic bomb could wipe away a city or a



Below: Accompanied by a T-33, Starfire F-94C 50-957 test fires a salvo of nose-mounted FFARs. The projectiles leave an impressive smoke trail, temporarily blinding the Starfire's crew.





Right: Starfire 50-966 was used by Lockheed as their photo publicity aircraft. The nose design was later adopted by the 354th FIS.

Below: The 97th FIS moved from Wright-Patterson AFB, Ohio to New Castle County Airport, Delaware in August 1955, at the same time receiving Starfires in place of its F-86 Sabres. The F-94Cs came from the 332nd FIS, which had moved to McGuire AFB, New Jersey.

military base. General Hoyt S. Vandenberg, Air Force chief of staff, predicted in 1952: "We can be expected to destroy no more than 30 per cent of the planes making an attack in strength on the United States before their bombing missions are completed." By 1956, when ADC was growing and squadrons of F-94s were being joined by F-86D Sabres and F-89 Scorpions – while Army Nike missile sites began to ring US cities – USAF officers felt they had a better chance against a bomber attack.

By 1954, the USAF was beginning to phase out the F-94As and F-94Bs, which had always been seen as performing an interim role, notwithstanding their special status as combat veterans. They joined the ANG (Air National Guard) as replacements for the F-51 Mustang with the 137th FIS of the New York ANG at Westover County Airport, White Plains, New York, followed by the F-94C. The F-94's ANG career was brief, the type equipping 21 ANG squadrons at one time. The 179th FIS of the Minnesota ANG at Duluth was the final user of the type, and gave up its F-94s during the summer of 1959.

'Interim' solution

Some 854 F-94s came off Lockheed's production line in Burbank, California. In retrospect, the F-94 was an 'interim' solution to air defence. Built in smaller numbers than the F-80 (1,714) or T-33 (6,557), it was well known for a brief time, then receded into history – not advanced enough or long-legged enough for a longer or brighter service career. Today, about 40 F-94s survive for display purposes but it seems unlikely that any will ever fly again.

Robert F. Dorr

Flying the F-94C

by Jim McNicholas
(60th FIS, Otis AFB, Massachusetts)

Pilots and ROs first met each other at Moody AFB, Georgia where they were paired for training in the B-25 Mitchell bomber, which carried its flight crew, two pilots being trained, two ROs being trained, and two instructors.

Several things come to mind regarding that training, and that tour of duty. At Moody we had to fly the aircraft through thunderstorms as part of the curriculum, before you could graduate. I remember bright lightning, and the altimeter registering 6,000-8,000 ft (1830-2440 m) variations without attitude changes (and the concomitant *g* forces which accompanied those rapid changes) above and below the assigned altitude, as a result of the turbulence inside those thunderheads. I also remember how dark it got, and the St Elmo's fire that lit up the canopy as a result of the electrical charges in the clouds, and the resulting static electricity on the exterior of the aircraft. The AF now realises that the forces in thunderstorms have never been accurately/adequately measured, and as a result has, I believe, banned intentional storm penetrations in today's flight environment.

Pilots and ROs then went to Tyndall AFB, Florida for their initial training in the F-94 before going to their squadrons.

I never doubted the structural integrity of the aircraft. It was a very sturdy, if not the steadiest, weapon system. It was well built, and control response, although state of the art then, was no match for the aircraft that followed. As I recall, flight controls were controlled by cables and pulleys (perhaps a 'hydraulic assist' system) – but it could be flown without hydraulic power, unlike today's 'hydraulically actuated' or 'fly-by-wire' (electrical) systems. The *g* limit was 7.33.

The aircraft had good acceleration. Take-off was in the order of 1,800- to 2,400-ft (550- to 730-m) rolls (dependent on temperature) with a pronounced attitude change at lift-off speed, when the nosewheel broke ground. It carried 48 FFAR rockets – 24 in the nose, and 12 each on the wingtip pods. The fire control system (controlled in the rear seat) showed a diminishing circle as the aircraft approached within firing range, and illuminated a large X when the rockets fired. We 'live fired' on radar targets towed by T-33s, and ran practice intercepts on other aircraft when ordnance was not loaded – recording the training intercepts for post-landing critique.

The aircraft experienced a mild 'control reversal' in the transonic speed range, as did several other models of that time period. The afterburner detent was full throttle and then outboard and forward. As a result, many of us still wear watches on the inside of the left wrist, because the crystals would break if the watch contacted the cockpit wall, when selecting afterburner.

The aircraft was 'honest'. There were no peculiarities, such as pitch-up or pilot-induced oscillations, which were encountered in follow-on designs. It was a fully acrobatic aircraft, with few restrictions except for engine limitations regarding fuel and oil during negative *g* conditions. It also was a good plane for all the formation flying we did, en route to the intercepts (easy to maintain a position, and good throttle and flight control response).

The nature of the mission required high power settings, including extended A/B operations. Consequently, most missions were 40-50 minutes in duration, although under normal cross-country flight conditions fuel was adequate for 1½- to two-hour sorties. The mission was exciting, and if it took you five minutes to get airborne when the 'scramble' horn sounded, you were considered slow. Most scrambles took an average of three minutes to get airborne. The crew chief normally started the engine, while we strapped in. Then the throttle went to 100 per cent to leave the hangar, and, barring a clearance delay, was seldom retarded before it was time to light the A/B for take-off. Of course, ADC alert hangars were constructed in close proximity to the end of the runway, so we did not have far to taxi. An 'Alert Tour' was generally 24 hours, and we slept and ate in the Alert Hangar, usually in our flight suits.

F-94C '50-1054' (actually 50-980) is displayed at the USAF Museum in the colours (blue and white checks) of the 60th FIS. The real 50-1054 was displayed at Monument Beach, Massachusetts.

Lockheed F-94 Variants

YF-94

The YF-94 designation (Lockheed Model 580) went to a pair of hand-tooled service-test ships that paved the way for the planned F-94A interceptor. Lockheed built two YF-94s, which differed not just from each other but from every other airframe in the series. Both were powered by the 5,200-lb (23.13-kN) static thrust Allison J33-A-33 engine rather than the Pratt & Whitney J48-P-5 that was to become standard on the F-94C. The YF-94s introduced afterburners not previously found on aircraft in this Lockheed family.

The first YF-94 (48-356, c/n 580-5001) began on the production line as simply one more in the routine factory 'run' of 238 P-80C fighters. The USAF belatedly dropped its P-for-pursuit terminology and changed the designation to F-80C on 11 June 1948. By then, this ship had been modified with a tandem, two-seat configuration, had been briefly known as a TP-80C, and became a TF-80C, the prototype for a long and spectacularly successful series of trainers that taught jet flying to tens of thousands in the 1950s and 1960s. It was briefly known as the ETF-80C, the 'E' suffix signifying 'exempt' from assignment to operational duty. The USAF changed the TF-80C terminology on 5 May 1949 and created the designation T-33A for Lockheed's immortal 'T-bird'. (The success of the trainer is best illustrated by the fact that Lockheed built 5,691, Canadair 656, and Kawasaki 210 for a total of 6,557 flying machines – about four times the 1,714 F-80s of all models and 7.5 times the 854 F-94s interceptors.)

After yet another designation change to ET-33A, it flew as the first YF-94 and still later in F-94A and F-94B configuration. In short, the first aircraft in the interceptor series had no fewer than nine designations as P-80C, TP-80C, TF-80C, ETF-80C, T-33A, ET-33A, YF-94, F-94A and F-94B. It was the progenitor of a small but important family of Air Defense Command fighter-interceptors that may have helped deter a third world war. The pioneering role of this first airframe is so little appreciated that for more than four decades it has been resting outside, exposed to the elements, on poorly-maintained display at Lackland Air Force Base in San Antonio, Texas.

Afraid that the noise around the Burbank factory might upset the local populace, Lockheed trucked the YF-94 to nearby Van Nuys where it was possible to fly straight out to sea. When it first flew there in YF-94 configuration, on 16 April 1949 with Tony LeVier at the controls and Glenn Fulkerson in the back seat, the first ship had the distinct upturned nose that was to characterise the future F-94A and B, the early frameless T-33-type canopy, and 'teardrop' fuel tanks hanging beneath the wingtips. It lacked the radar, weaponry, and other internal items that were to become standard for operational F-94 interceptors. At first, its job was to be an aerodynamic 'proof of concept' vehicle. Test pilot reports indicated few problems. The afterburner was temperamental in early flights until its maker, Solar, created a redesigned flame-holder system.

The second YF-94 airframe began life as the 18th TF-80C (48-373 c/n 580-5018). Unlike the first ship, it apparently never was retrofitted with the four 0.5-in. (12.7-mm) machine-guns that became standard armament for the F-94A and B. The second airframe underwent minor changes and was redesignated EYF-94 in January 1953, then EYF-94A in September 1954. It left USAF inventory in February 1956 and has not been preserved.

YF-94 serials: 48-356, 48-373 (2)
Total YF-94 conversions: 2

Above: Here the first F-94 (48-356) is seen sporting underwing drop tanks of the type fitted to T-33s.

Right: FA-356 later flew with Fletcher centre-mounted tip tanks.

The second YF-94 started life as a T-33A and is seen here without tip tanks. As may be seen, the changes made to the T-33A airframe to create an F-94A were comparatively minor, centring on the nose, tailfin and rear fuselage. Note the early 'bone domes' worn by the crew.

F-94A

The F-94A joined the US Air Force as its first operational all-weather jet interceptor. The configuration was nearly identical to the service-test YF-94 prototypes but with internal equipment, including radar and guns, installed from the start. The crew comprised pilot in the front seat and RO (radar observer, more commonly called a radar operator) in the back.

The upturned snout of the F-94A housed the Hughes E-1 fire control system, which incorporated the A-1C gunsight and AN/APG-33 air intercept radar. Beneath and behind the radar were the four 0.5-in (12.7-mm) machine-guns with 300 rounds each that comprised armament for the F-94A and B models. The belted ammunition was in boxes mounted just ahead of the forward cockpit firewall and just behind the radar system avionics boxes.

Lockheed workers literally hand-crafted the first 17 A models (49-2479/2495) which were F-94A-1-LO sub-variants and had conventional fixed seats. Thereafter, the production line began turning out 92 F-94A-5-LOs (49-2496 and 49-2498/2588) equipped with ejection seats.

The USAF ordered the A model beginning in January 1949, in the immediate aftermath of the detonation of the first Soviet nuclear device – at a time when the defence of North America was a top priority to Pentagon planners. The first F-94A flew on 1 July 1949. With some initial hitches, Lockheed put the A model into production several months later and delivered F-94A interceptors between December 1949 and December 1950.

The F-94A entered service with the 319th FIS at Moses Lake AFB and the 317th FIS at McChord AFB, both in Washington, in May 1950. The F-94A appeared briefly in the Korean theatre before the subsequent F-94B became the principal variant to see combat. The USAF progressively upgraded its F-94A fleet over its service life of just half a decade. The early, one-piece canopy was replaced by a canopy with a bow frame at the centre, between the two crew members, an eventual characteristic of all F-94 models and of the T-33 trainer series. Configured initially to carry 'teardrop' tip tanks slung under the wing, some F-94As eventually received the centre-mounted 230-US gal (870-litre) tank that was initially an identifying feature of the subsequent F-94B.

Cornell Aero Lab at Buffalo, New York operated a single F-94A (49-2500/N941BH) for early variable stability flight trials before acquiring a T-33A (itself configured to resemble an F-94A) that was more fully equipped for the research.

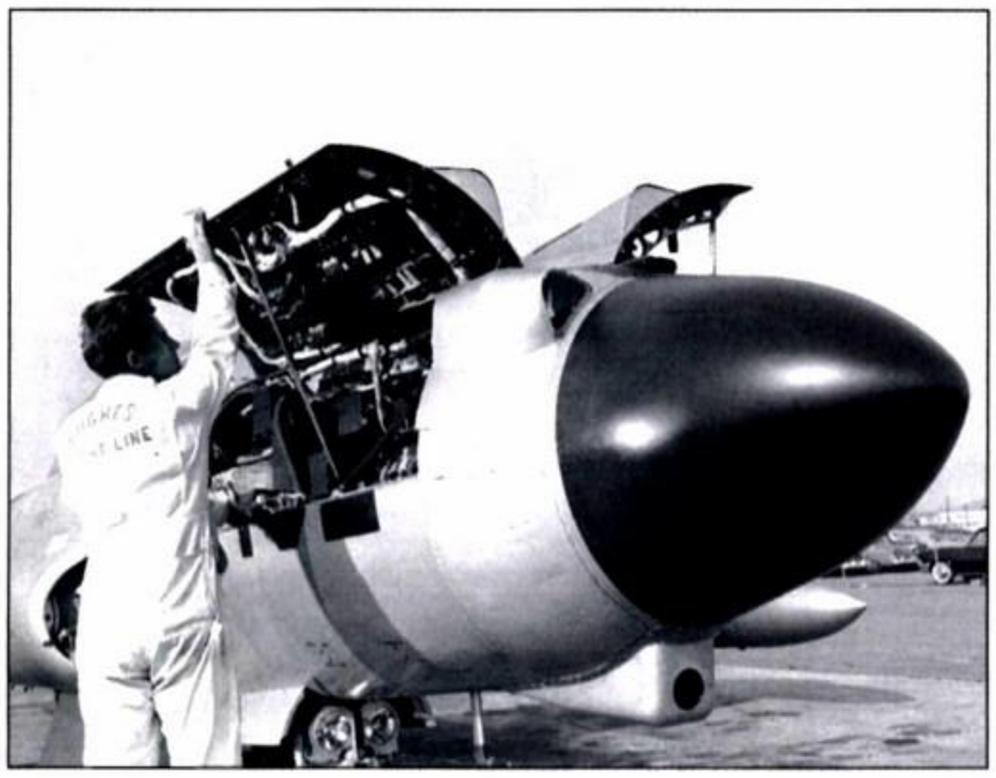
F-94A serials: 49-2479/2495 (17); 49-2496 (1); 49-2498/2588 (91)
Total F-94As built: 109

Above: F-94A 49-2569 of the 175th FIS, South Dakota ANG carries gun pods, each with a pair of 0.5-in (12.7-mm) machine-guns and 265 rounds per gun.

Above: F-94As carried a variety of jettisonable underslung tip tanks before centre-mounted tanks were adopted on the F-94C and retrofitted to earlier aircraft. 49-2567 carries the larger so-called 'Misawa' 265-US gal (1003-litre) tip tanks of the type manufactured in Japan during the Korean War.

Left: This brand new F-94A, seen at Van Nuys Airport though destined for service in the Arctic, sports early 165-US gal (625-litre) tip tanks

Lockheed F-94 Variants



F-94A 49-2492 served as a testbed aircraft with Hughes during the development of the E-5 fire control system for the F-94C (right). Fairings either side of and under the radome housed cameras. Note the rocket tube brackets on the inside of the upper doors (left). The presence of camera equipment suggests that the lower rocket bays were equipped. The nose radome is of the later, more aerodynamic type that was eventually standard on Starfires.

YF-94B

The YF-94B service-test 'dogship' – at the time, the popular American term for a flight test vehicle – was the airframe which otherwise would have been completed as the 19th F-94A (49-2497). This forerunner of the B model reflected the intention of both Lockheed and Air Force leaders to develop the F-94 series incrementally. Lockheed modified it during production to test improved equipment and systems planned for the operational F-94B.

YF-94B serial: 49-2497 (1)
Total YF-94Bs modified: 1

F-94B 51-5329 (NACA/NASA 203) was acquired in 1956 at Lewis, where it was used for aerodynamic noise tests.

F-94B

The F-94B quickly supplanted the F-94A in operational Air Force units, became the only variant in this series to see combat, and introduced improvements while remaining generally similar in appearance to the F-94A. Powerplant on the F-94B was the same J33-A-33/33A with afterburner found on earlier models.

The F-94B differed little from the A model, but importantly it introduced a Sperry Zero Reader which could be coupled to the ILS (Instrument Landing System) indicator to give the pilot an in-cockpit reading of his glide slope during bad-weather landings, an invaluable tool in the all-weather intercept business. The B model also introduced adjustable seats, an upgraded hydraulic system, a high-pressure oxygen system, and centre-mounted wing 230-US gal (870-litre) tip tanks developed by Fletcher. The tip tanks remained an identifying feature of the B model, and held slightly less fuel than the similar tanks on the F-94C.

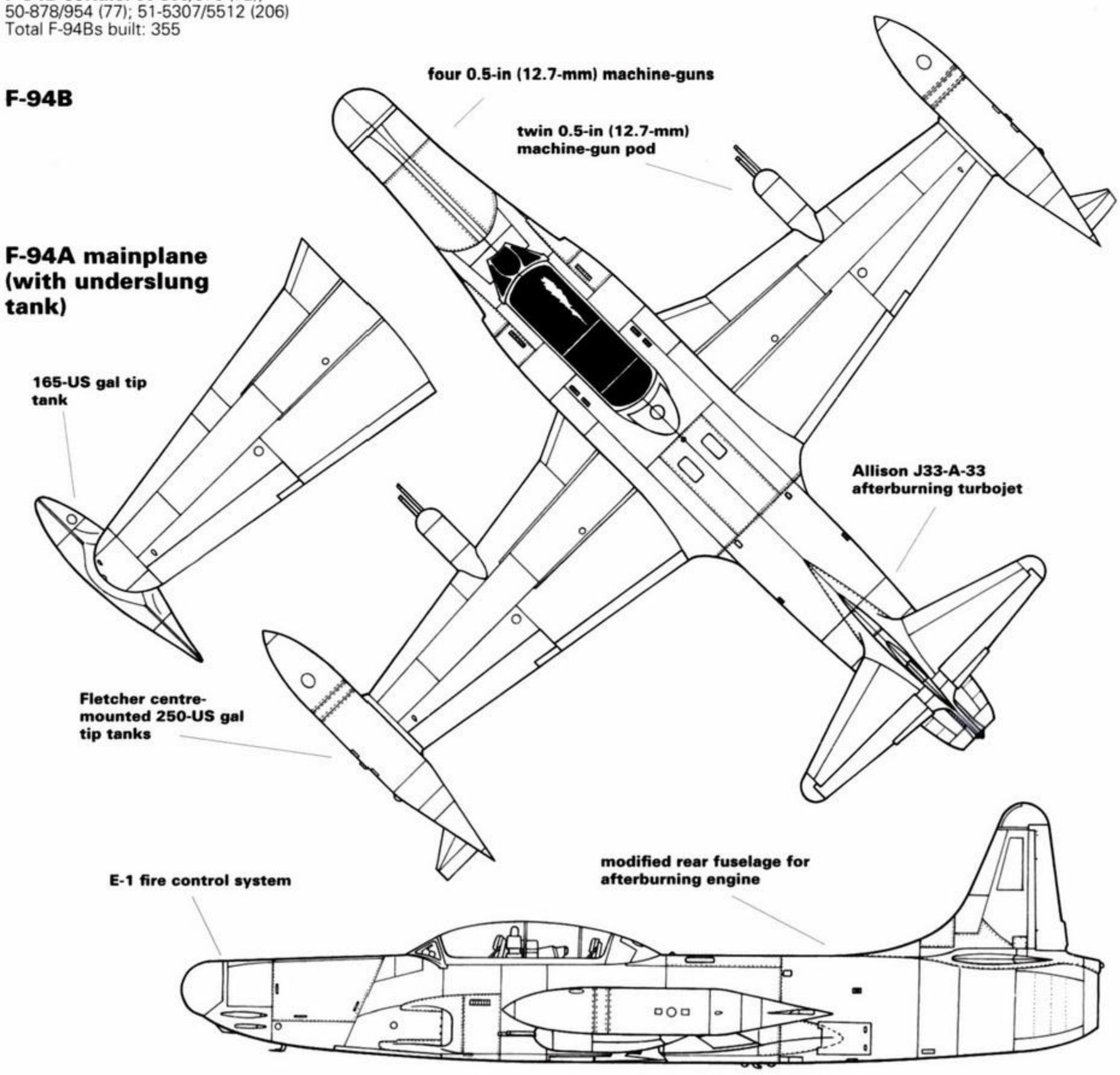
Late in their service careers, surviving F-94A/B interceptors were modified by having their cockpits widened to improve the chance of successful ejection in an emergency.

Two of the aircraft in the F-94B series (51-5500/5501) were modified to become partial service-test prototypes for the F-94D ground attack model, and were themselves redesignated YF-94D (separate entry). Lockheed proposed a two-seat radar combat trainer version of the F-94B, known in some documents as the L-199, but the aircraft was not developed.

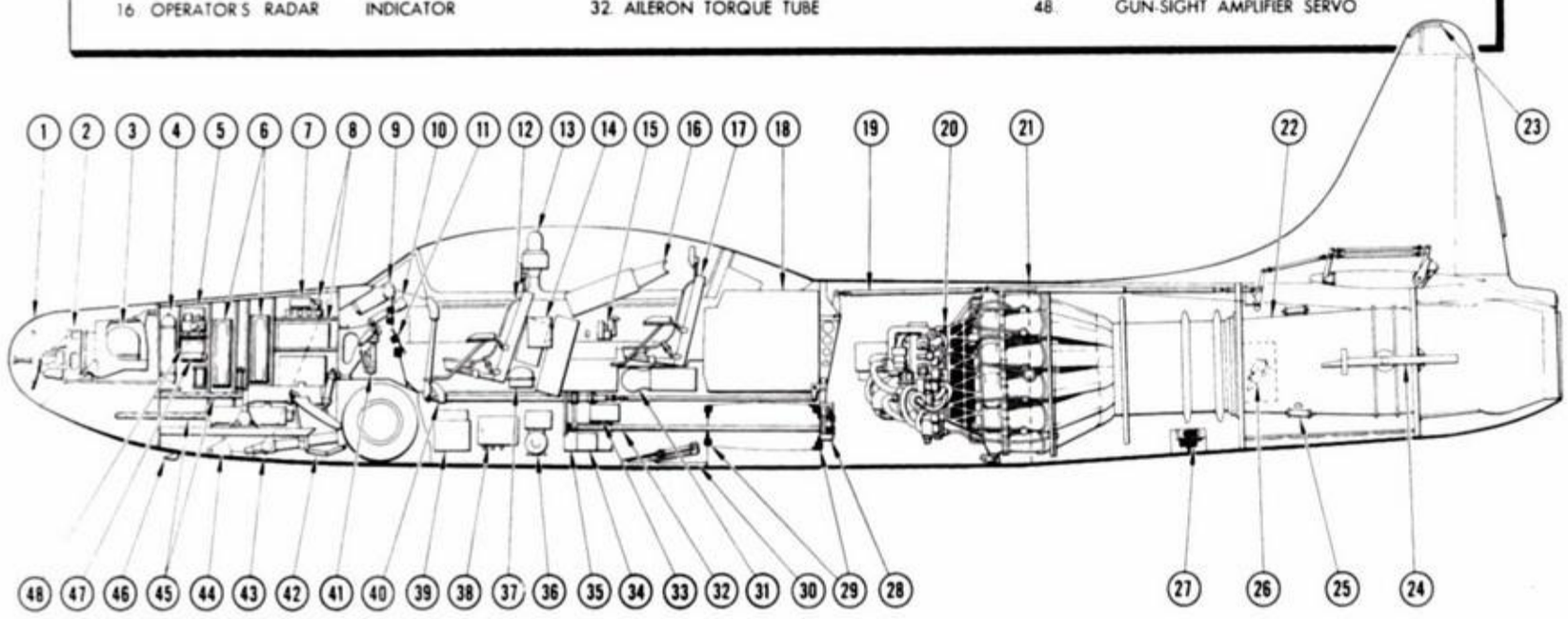
A single F-94B (50-805) was modified to test wing-mounted gun pods which doubled the gun armament of the F-94A and B models. Mounted at mid-wing protruding from the wing leading edge, one on each side, were two forward-facing pods each containing two Browning M3 0.50-in (12.7-mm) machine-guns. The F-94C model, which otherwise had rocket-only armament, was also capable of carrying the pods. Surprisingly, the pods created very little drag while increasing the weight of the aircraft only marginally. The wing-mounted gun pods were available for operational use during the final years of the brief career of the F-94 series but there is little evidence that they were actually employed.

NACA (renamed NASA on 1 October 1958) operated two F-94Bs: 51-5380 was used by NACA/Langley (at Langley AFB) in the mid-1950s, but records of its NACA number (if any), the dates of its use and the purpose to which the aircraft was assigned are unclear. The second airframe, 51-5329 (NACA/NASA 203), was acquired in April 1956 at Lewis (Cleveland, Ohio) where it remained until December 1959.

F-94B serials: 50-805/876 (72); 50-878/954 (77); 51-5307/5512 (206)
Total F-94Bs built: 355


F-94B
four 0.5-in (12.7-mm) machine-guns
twin 0.5-in (12.7-mm) machine-gun pod
F-94A mainplane (with underslung tank)
165-US gal tip tank
Allison J33-A-33 afterburning turbojet
Fletcher centre-mounted 250-US gal tip tanks
E-1 fire control system
modified rear fuselage for afterburning engine

1 PLASTIC NOSE
2 RADAR ANTENNA
3 RADAR MODULATOR
4 OXYGEN BOTTLE
5 RADAR RANGE SERVO GEAR BOX
6 AMMUNITION BOXES (4)
7 C-1 POSITION LIGHT FLASHER
8 AN/ARC-3 AND AN/ARN-6 RADIO RECEIVERS
9 GUN-SIGHT
10 PILOT'S RADAR INDICATOR
11 INSTRUMENT PANEL
12 PILOT'S SEAT
13 AN/ARN-6 RADIO COMPASS LOOP ANTENNA
14 RADAR INDICATOR POWER SUPPLY
15 RADAR MANUAL CONTROL
16 OPERATOR'S RADAR INDICATOR
17 RADAR OPERATOR'S SEAT
18 FUSELAGE FUEL TANK
19 ELEVATOR CONTROL ROD
20 J33-A-33 ENGINE
21 FUSELAGE AFT-SECTION ATTACHING POINT
22 AFTERBURNER
23 AN/ARC-3 RADIO ANTENNA
24 AFTERBURNER TRACK
25 AFTERBURNER EYELID ACTUATOR
26 ELEVATOR TAB MOTOR
27 GYROSYN COMPASS FLUX VALVE
28 AILERON BOOSTER UNIT
29 WING BEAMS
30 DIVE FLAPS
31 TURBINE AND COOLER UNIT
32 AILERON TORQUE TUBE
33 CABIN AIR MIXING VALVE
34 INTERPHONE AMPLIFIER
35 D-2 INVERTER
36 RADAR INVERTER
37 RADAR VERTICAL GYRO
38 RADAR
39 BATTERIES
40 AILERON-ELEVATOR CONTROL ASSEMBLY
41 RUDDER PEDALS
42 NOSE ALIGHTING GEAR
43 FUSELAGE NOSE-SECTION ATTACHING POINT
44 CASE EJECTION DOOR
45 MACHINE GUNS (4)
46 AIR-SPEED PITOT
47 GUN-SIGHT COMPUTER
48 GUN-SIGHT AMPLIFIER SERVO



Left: This Lockheed drawing shows the placement of the F-94B's internal components. In transforming the T-33, Lockheed crammed a considerable amount of new equipment into a relatively small airframe.

The AN/APG-33 radar at the heart of the F-94A/B's E-1 fire control system was developed from the AN/APG-3 radar used to guide the Convair B-36's tail armament.

NF-94B

A single NF-94B (51-5502) was used to test various components of the F-99 BOMARC (BOeing and Michigan Aeronautic Research Center) surface-to-air missile guidance system for compatibility in flight (vibrations, turning, etc). The 'N' prefix signifies an aircraft that has been modified to a new configuration but can eventually be restored to its original shape. The modification extended the nose by about 17 ft (5.18 m). Lengthening of the nose necessitated addition of equipment and ballast in the rear of the aircraft. Separate hydraulic and electrical systems were added for the missile guidance system, and ammonia and nitrogen tanks were added for cooling and pressurising the missile nose.

Originally known as the GAPA (Ground-to-Air Pilotless Aircraft), the BOMARC was a rocket- and ramjet-powered interceptor missile produced for the US and Canadian armed forces through 1962. Initially deemed a 'fighter' and designated the F-99, it was redesignated IM-99 on 30 April 1955 and CIM-10 on 1 October 1962. Intended to have longer range and greater flexibility than the Army's Nike missile, BOMARC was in many respects an unpiloted aircraft and required a great deal of testing with aircraft as platforms.

Like the F-94 itself, BOMARC – with its atomic warhead – was a product of an age when the Pentagon brass grimly expected that nuclear warheads would be used eventually in a US-Soviet exchange. On 7 June 1960 a BOMARC-A at McGuire AFB, New Jersey suffered an explosion of a helium pressurisation tank which ruptured the booster fuel tanks (hypergolics), resulting in a fire which destroyed the missile. The high explosives in the Mk 40 Mod 1's warhead burned but did not detonate. Since the Mod 1 warhead lacked a single-point 'safe' system found on later nuclear weapons, experts believe it could have detonated – and could have dramatically changed events at the time.

The BOMARC-nosed F-94 (crammed with electronics but no nuclear material and no warhead) was one of at least three such aircraft fitted with the long, slender proboscis of the missile, the others being B-57B Canberras (52-1493 and -1497). The B-57Bs were modified by Temco under contract to Boeing; it is unclear whether the same company modified the NF-94B.

NF-94B serial: 51-5502 (1)
Total modified: 1

NF-94B 51-5502 and B-57B 52-1497 are seen here during the BOMARC test programme.

YF-94C

Although it never carried air-intercept radar, 50-955 was modified late in life so that it approximated the production F-94C configuration. Changes included the addition of an early, blunt F-94C radome and nose armament of 24 2.75-in (70-mm) rockets. The aircraft retained a nose pitot boom that was non-standard. The USAF also ordered a second prototype (50-877). Both were redesignated YF-94C on 12 September 1950.

YF-94C serials: 50-877, 50-955 (2)
Total YF-94C built: 2

The incorrectly applied 'F94-C' marking on the nose of 50-955 was later amended to read 'F-94C'.

F-94C Starfire

The F-94C Starfire (the only variant in the series to which the name was assigned) became the definitive interceptor version in this series. Powerplant was a departure from the F-94A/B series, being the 6,350-lb (28.24-kN) (8,750 lb/38.91kN with afterburner) thrust Pratt & Whitney J48-P-5, -5A, or -7A centrifugal-flow turbojet engine, a licence-built development of Britain's Rolls-Royce Tay. Approximately the first 20 aircraft had somewhat less powerful J48-P-3s, which were later upgraded to -5 standard.

The F-94C dispensed with gun armament. It carried 24 2.75-in FFARs (folding-fin aircraft rockets) in four clusters surrounding the radome of its APG-40 radar, an aerial arsenal that was soon doubled with the addition of 24 more rockets in two mid-wing fairings. ADC experts said the armament of the F-94C was far more accurate than that of the F-86D, which had a retractable tray of the same projectiles, because the F-94C employed closed-breech launchers. Initially flown with a blunt-shaped radome, the F-94C Starfire quickly acquired a more pointed nose shape that became standard.

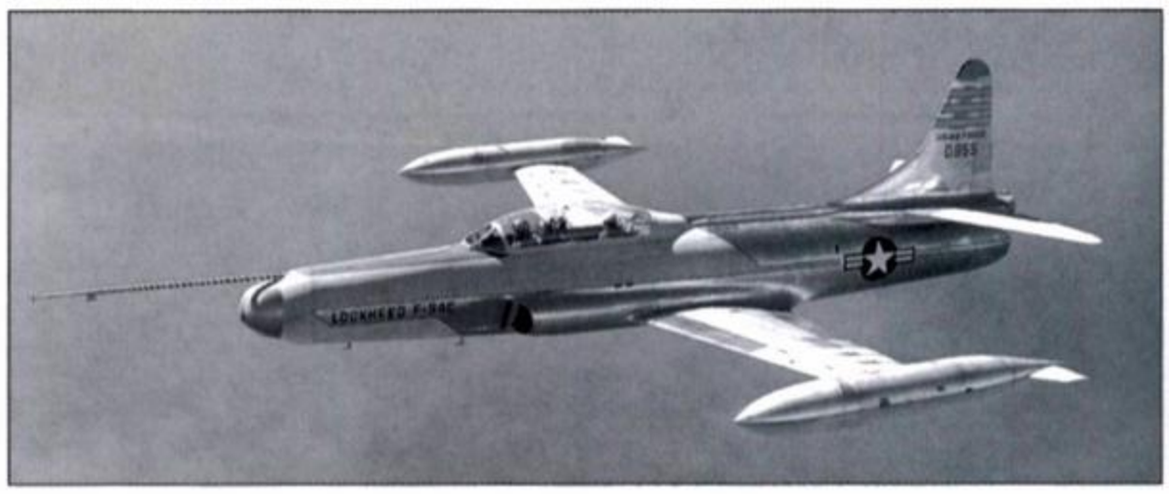
With a maximum weight of 24,184 lb (10970 kg), the F-94C was significantly bigger and heavier (by about 30 per cent) than the F-94A/Bs, which had similar weights and dimensions. Its fuselage length of 44 ft 6 in (13.56 m) made the F-94C 4 ft 5 in (1.35 m) longer than the F-94B, and its fin height of 14 ft 11 in (4.55 m) made it more than 2 ft (0.6 m) higher than a B. Significant changes to the wing reduced the C's span by about 2 in (5 cm). The F-94C carried mid-mounted 250-US gal (946-litre) wingtip tanks and, for ferry flights, was capable of accommodating two 230 US-gal (870-litre) drop tanks mounted on pylons at the wing centre. The F-94C introduced a brake parachute, becoming the first operational fighter to use one.

A 'first flight' date for the standard F-94C aircraft does not appear in available records. The 437th FIS at Otis AFB, Massachusetts became the first line squadron to receive the F-94C Starfire, in March 1953. The active-duty USAF retired its last operational F-94C from the 60th FIS at Otis just half a dozen years later, in 1959, as 'Century Series' interceptors (F-101B/F Voodoo, F-102A Delta Dagger, F-106A/B Delta Dart) began to equip ADC. The F-94C served only briefly in Air National Guard squadrons, beginning with the Massachusetts ANG's 101st FIS in 1956 and concluding with Minnesota's 179th FIS in 1959.

One F-94C was modified to DF-94C standard, and another to become an EF-94C (separate entries). Hughes operated at least one camera-equipped F-94C (50-965) which did not acquire a separate designation. NACA (the National Advisory Committee for Aeronautics) was the final user of the first F-94C (50-956/NACA 156), which tested a thrust-reverser with large clamshell doors between 1954 and 1958, having undergone wind tunnel testing by NACA in 1952.

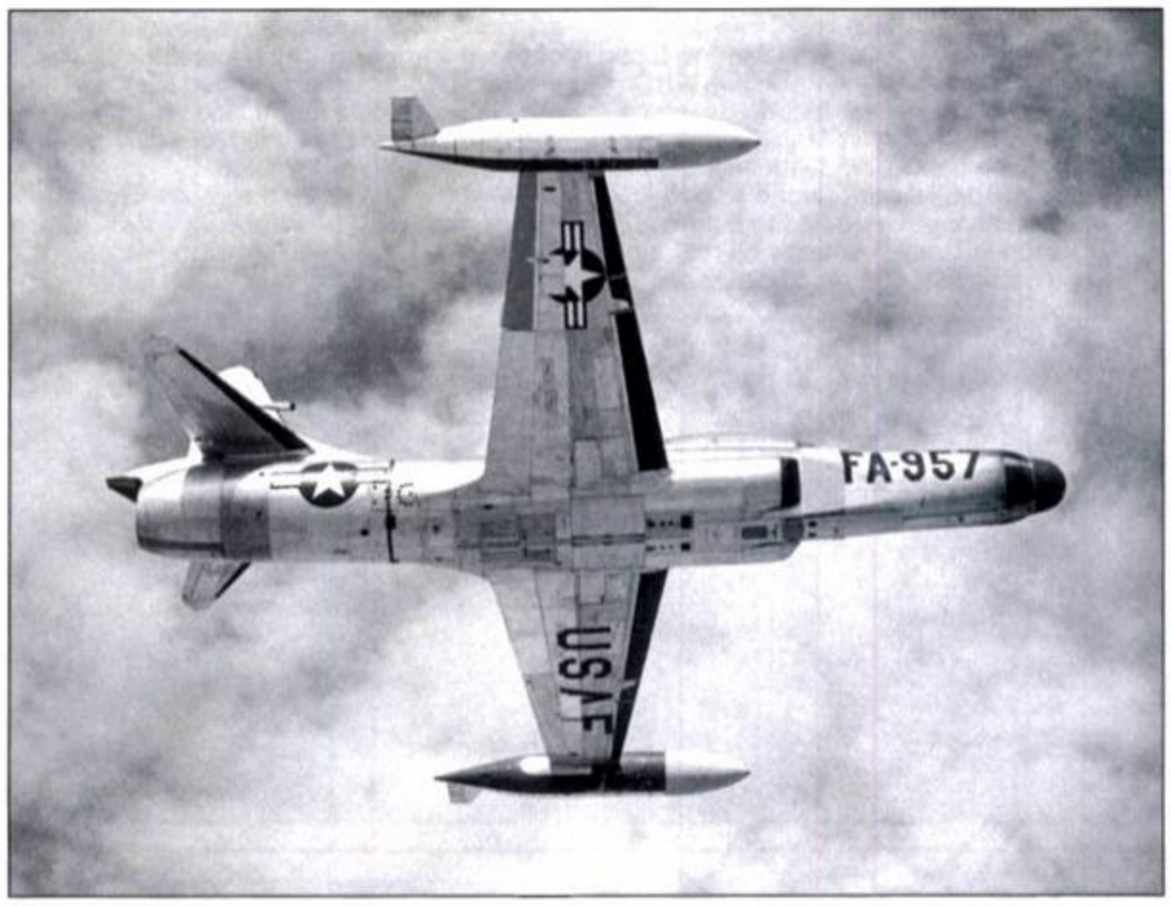
F-94C serials: 50-956/1063 (108); 51-5513/5698 (186); 51-13511/13603 (93)
Total F-94Cs built: 387

Spectacularly finished in polished aluminium and Dayglo, YF-94C 50-955 was flown by Lockheed as a systems and aerodynamic test ship. Note the aluminium radome (radar was not initially fitted) and the frameless canopy.



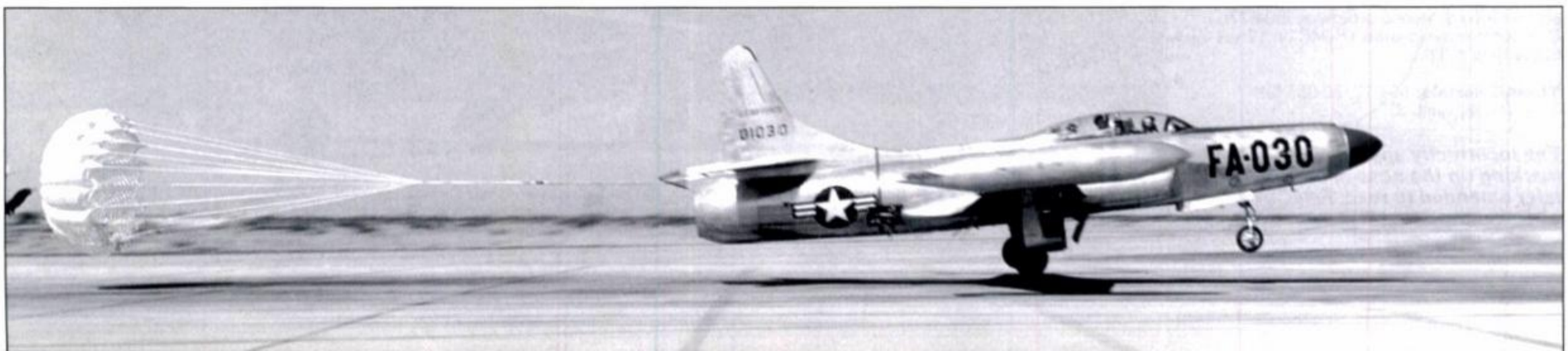
Below: The second production Starfire, 50-957, served as an armament trials aircraft and carried a number of cameras to record the behaviour of the FFARs once fired. One of these may be seen here, on the leading edge of the aircraft's fin. Note the soot around '957's nose, suggesting a recent firing. FFARs could be fired all together or in four salvos of six rockets each, evenly spaced so as not to upset the aircraft's handling. The missile tubes were insulated and electrically heated.

Left: A Starfire of the 26th Air Division, winners of the 1955 Rocketry Meet, opens fire. The first three projectiles from the right-hand pod appear to have collided. If the rocket's fins failed to deploy, trajectories were unpredictable. The FFAR relied on the 'shot-gun' effect to score a kill.



Left: This top view of an early F-94C illustrates the deployed airbrakes, unusual swept tailplane and the painted inside surfaces of the drop tanks, the latter a measure to reduce glare suffered by the crew.

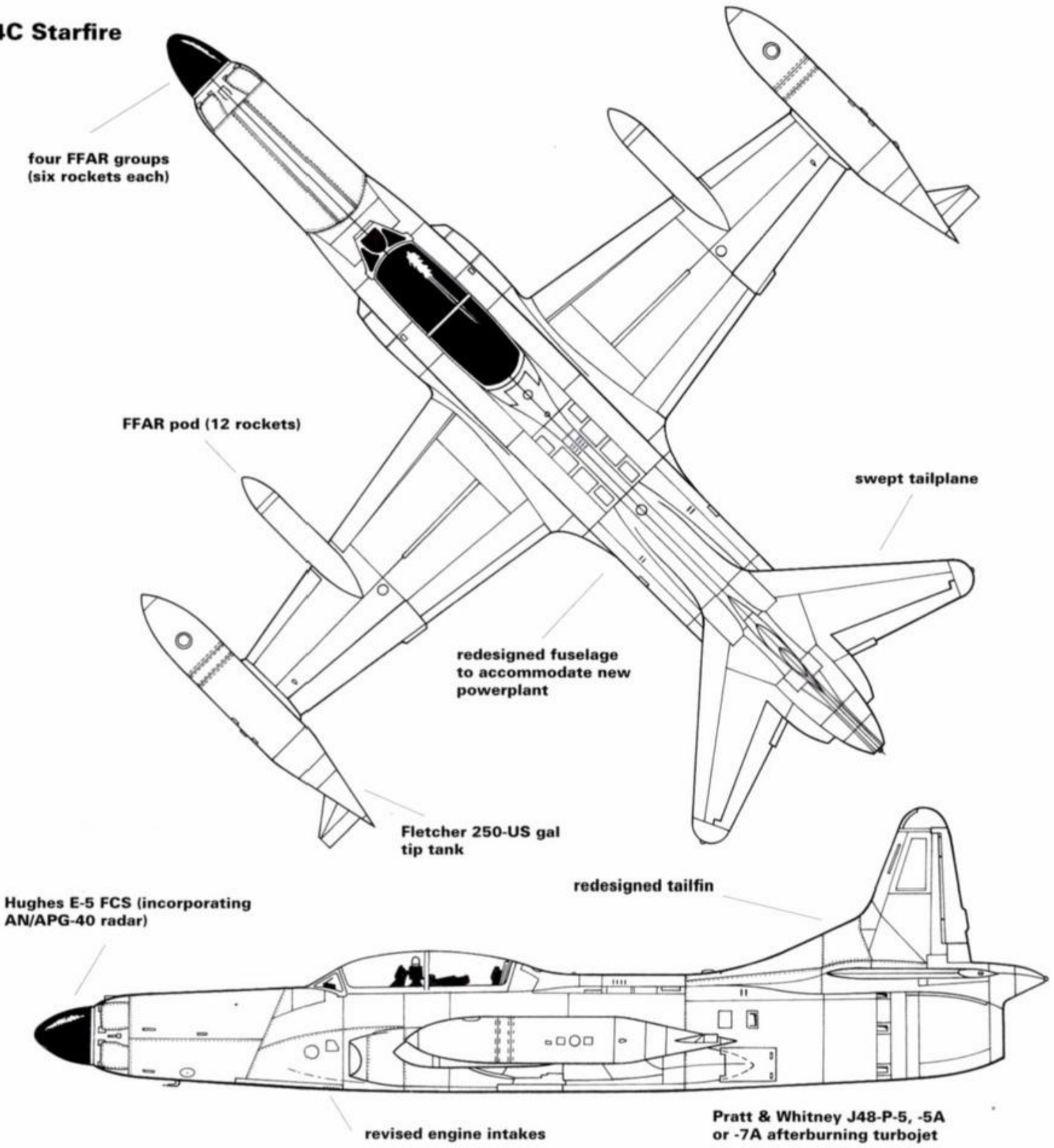
Below: The F-94C was the first USAF fighter to feature a drag 'chute. In the early days of their use, pilots were trained to repack their own 'chutes, as few ground crews were familiar with the process.



The F-94C's leading-edge rocket pods (above) were readily accessible from the ground and easily hand-loaded. Once replenished, a frangible plastic nose cone (below) was fitted. This shattered under the force of the rockets when fired.

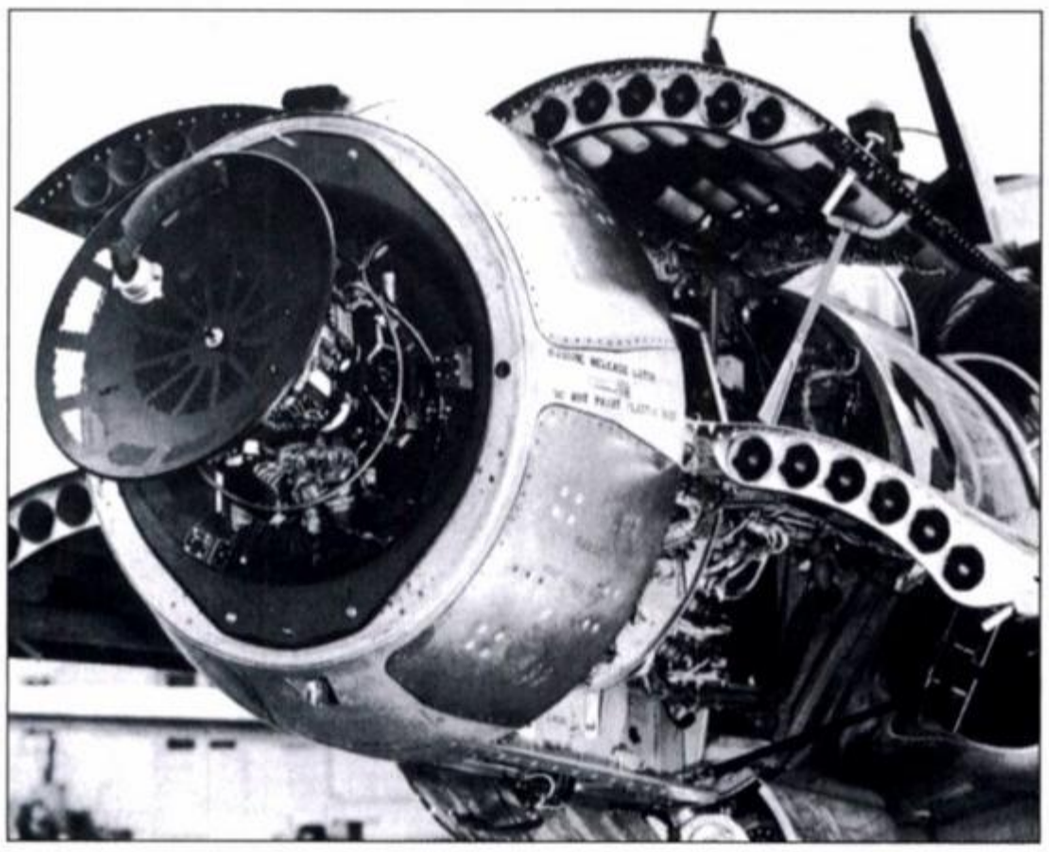
Below: This F-94C front cockpit is typical of early examples. Upper left is the radar scope and to its right is the 'gunsight'.

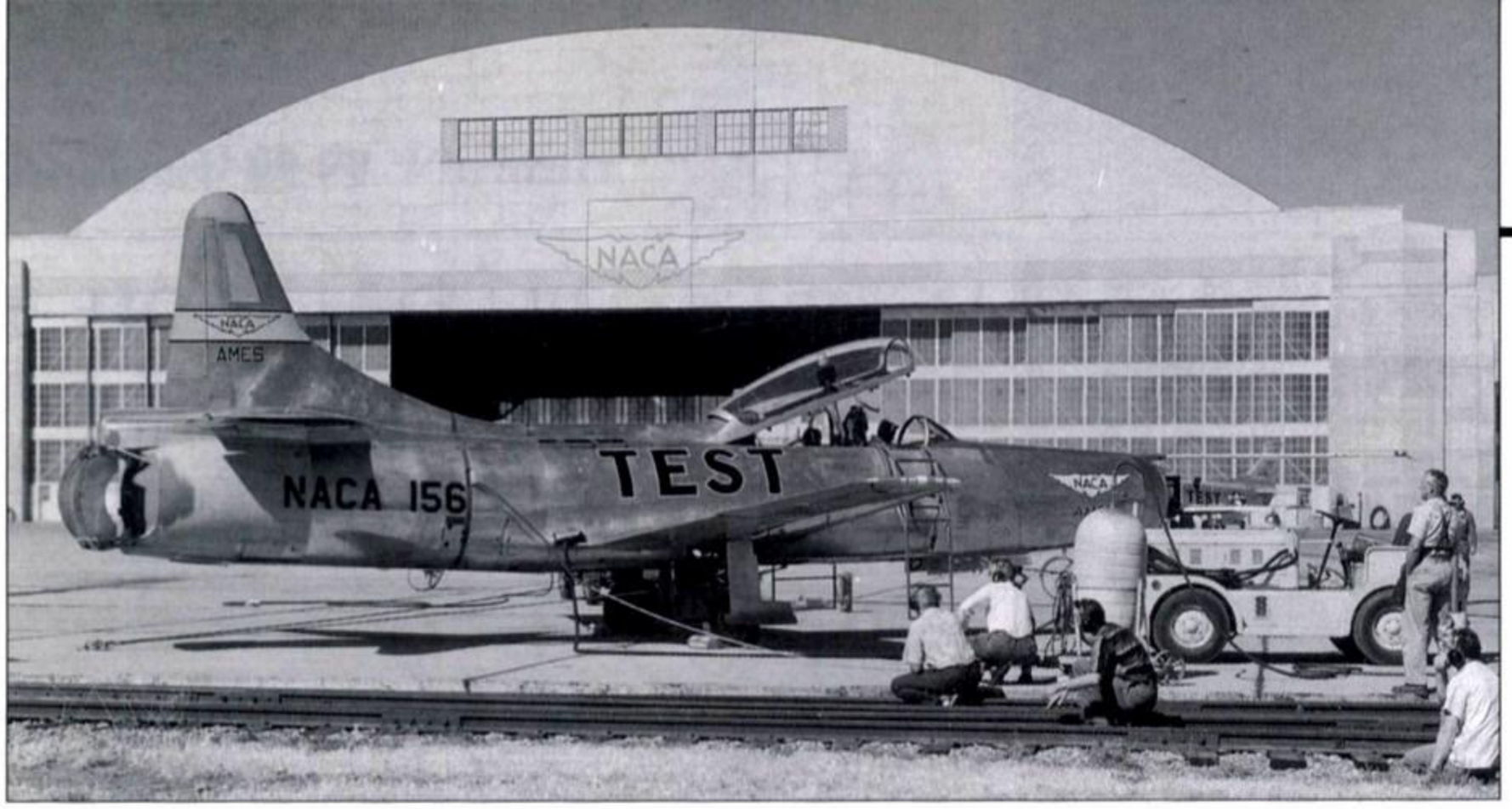
F-94C Starfire



Below left: The F-94C's AN/APG-40 radar was powerful for its day, tracking targets at up to 30 miles (48 km). Via the E-5 FCS, the radar provided range, speed, azimuth and elevation data to the aircraft's RO.

Below right: YF-94C Starfire 50-966 was used by Lockheed as its photo publicity aircraft. Here it is seen with its nose-mounted FFAR doors open for the camera.



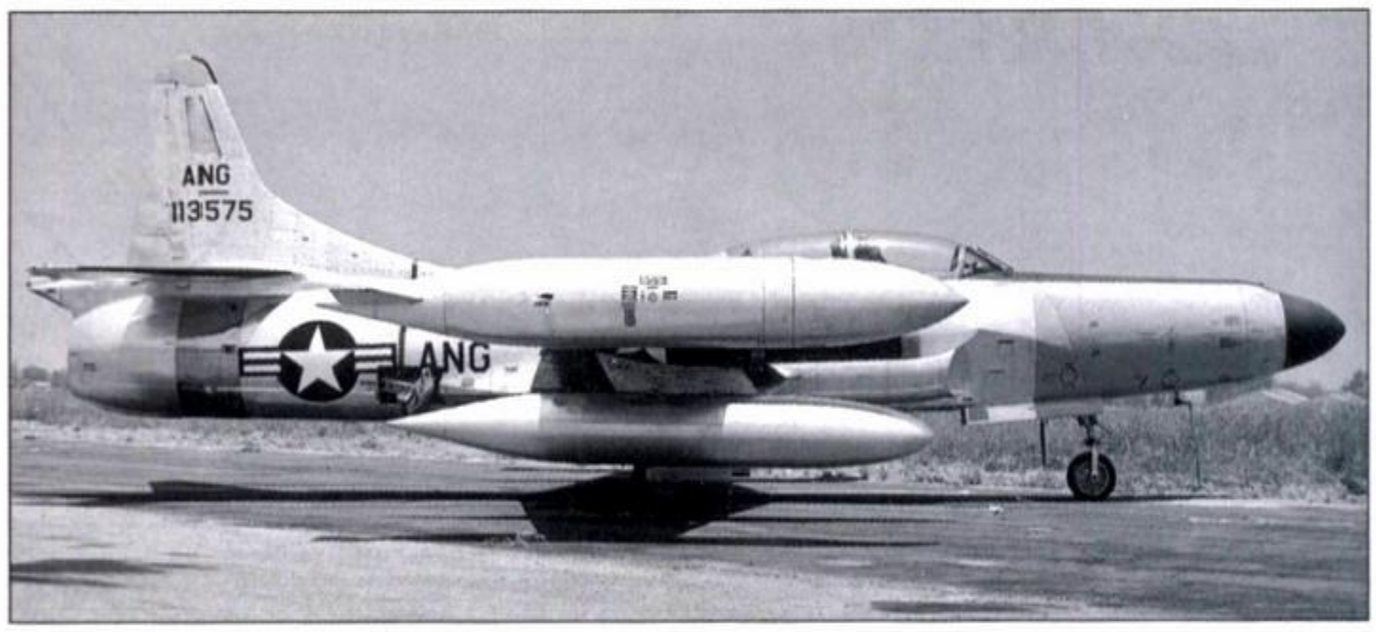


Left: Anchored firmly to the ground, NACA 156 (formerly 50-956) is seen during tests at NACA's Ames Aeronautical Laboratory, Moffett Field, California. Wind tunnel tested at Ames in early 1952, the aircraft was acquired again in 1954 by the High Speed Flight Research Center (later named Dryden, at Edwards AFB) to test an early thrust-reverser with large clamshell doors. The engine was run at full power while the clam-shell reverser was closed across the jet efflux and its effectiveness recorded. The device was later test flown, but crashed on 18 November 1958 at Edwards after the pilot failed to close the reverser.

DF-94C

At least one F-94C was modified to carry the Hughes XF-98/GAR-1 Falcon air-to-air missile for tests that led to the use of the Falcon on other Air Defense Command interceptors. For this purpose, the aircraft was given a 'D' prefix usually assigned to a 'drone director.' There is inconclusive evidence that this aircraft may have been the fourth F-94C built (50-959) and may have operated at Holloman AFB, New Mexico, which is near the White Sands missile range and was the home to a considerable amount of missile testing in the 1950s.

Right: In ANG markings, late-production F-94C 51-13575 sports two 230-US gal (871-litre) drop tanks, to augment the fuel capacity provided by the tip-mounted tanks of equivalent size. The two extra tanks added 2,800 lb (1270 kg) to the aircraft's gross weight, added 1,000 ft (305 m) to its take-off run and reduced climb rate considerably.



EF-94C

The sole EF-94C aircraft was the eighth F-94C (50-963), experimentally fitted with an enlarged nose containing reconnaissance cameras instead of radar and rockets. The modification apparently took place at Wright-Patterson AFB, Ohio, where the aircraft wore a Wright Air Development Center badge and the words 'FLIGHT TEST' at mid-fuselage. The aircraft was used solely as a sensor and camera testbed for ARDC (Air Research and Development Command) and was not regarded as a prototype for a tactical reconnaissance fighter, hence its E-for-exempt prefix.

Fitted with this bulbous sensor nose, the EF-94C was purely a testbed for ARDC programmes.

YF-94D

The YF-94D designation applies to three aircraft intended as service-test models for the F-94D (Lockheed Model 980) ground attack aircraft (separate entry). The first two aircraft were modified F-94B-5-LOs (51-5500/5501). Lockheed installed the redesigned F-94D nose and armament on these aircraft – moulding perhaps the ugliest proboscis ever installed on a modern fighter – but did not alter them to the proposed single-seat installation.

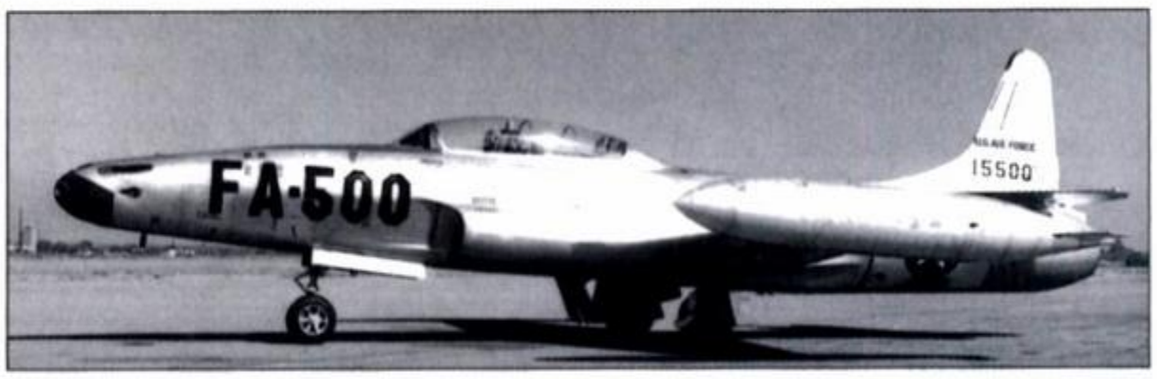
By the time these two aircraft took to the air, the USAF had cancelled its contact for the production F-94D, a measure reflecting the priority the service assigned to the interceptor mission and the defence of North America.

The two F-94D partial aerodynamic test vehicles were armed, 51-0500 with four 0.50-in (12.7-mm) guns, and 51-5501 with possibly as many as six. This armament appears to have been the same armament as that fitted to F-94As and Bs but with the guns mounted higher on the fuselage.

After the F-94D programme was cancelled 51-5500 was used as a testbed for the General Electric T-171 (later M61A1 Vulcan) 20-mm rotary cannon. It appears to have been armed with one such cannon, firing from the right side of the nose. This was not part of the F-94D effort.

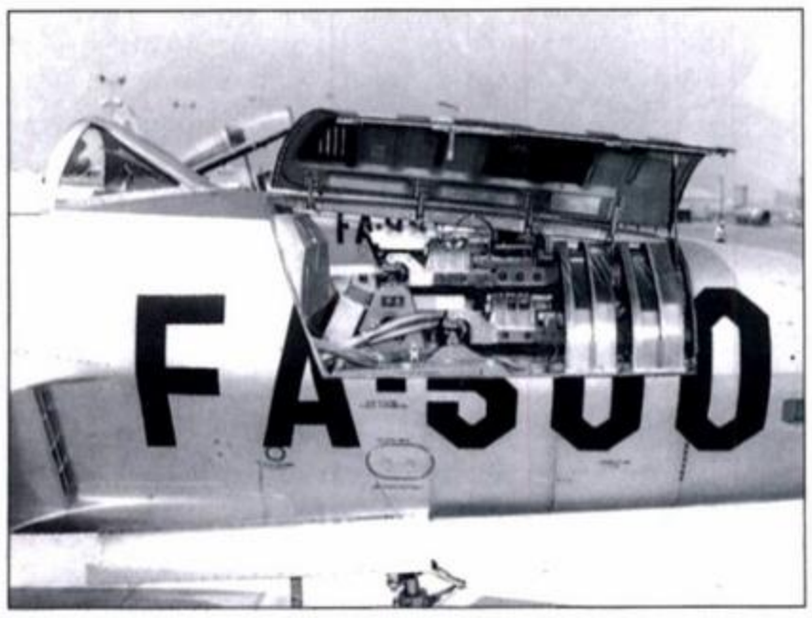
The YF-94D designation also applies to the first single-seat aircraft (51-13604) which was about three-quarters complete but, because of the contract cancellation, never rolled out of the factory or flew.

YF-94D serials: 51-5500/5501 (2)
Total YF-94Ds modified: 2



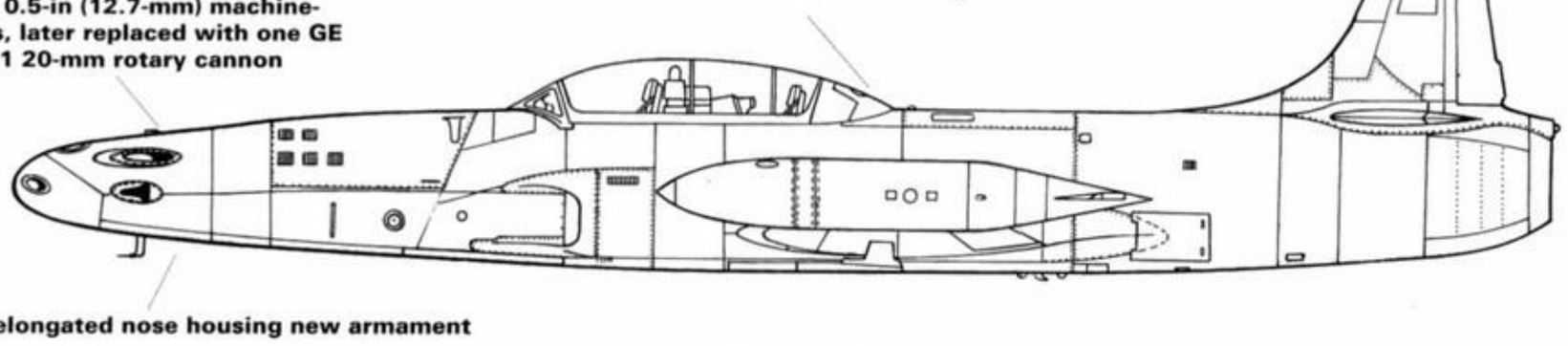
Above: Variously known as the 'Ant Eater' and 'Needle Peter', 51-5500 was fitted with an example of the GE T-171 cannon, firing through a port discernible near the centreline of the 'radome'. Known to the USAF as the M61A1 Vulcan, the T-171 was installed in the F-104 Starfighter and has been the standard internal gun for American fighters ever since.

Below and right: 51-0500 was initially fitted with four 0.50-in (12.7-mm) machine-guns in an elongated nose.



YF-94D 51-5500 was issued to the 131st FIS, Massachusetts ANG (with sister airframe 51-5501) in June 1954, at the conclusion of testing by Air Proving Ground Command at Eglin AFB.

YF-94D


four 0.5-in (12.7-mm) machine-guns, later replaced with one GE T-171 20-mm rotary cannon
standard F-94B airframe and engine
elongated nose housing new armament

F-94D

The F-94D designation was assigned to the production single-seat, ground-attack version, of which the USAF ordered 113 in January 1951 (51-13605/13716). This single-seater had a fuel capacity increased to 1,965 US gal (7438 litres) with the installation of additional fuel in the space occupied on earlier variants by a radar operator. The F-94D was designed with the powerplant, fuselage and tail surfaces of the F-94C but with a new wing that had 50 per cent greater area and provision for underwing fuel and ordnance.

The F-94D was to have been armed with eight 0.5-in (12.7-mm) machine-guns and provision for up to 4,000 lb (1814 kg) of ordnance. The F-94D would have been the only variant capable of receiving air refuelling, with a retractable probe situated in the upper nose section.

Although two service-test prototypes flew with the planned nose configuration, and a third aircraft was nearly completed for the service-test role, the USAF cancelled its F-94D purchase on 15 October 1951.

F-94D serials: 51-13605/13716 (112)
Total F-94Ds cancelled: 112

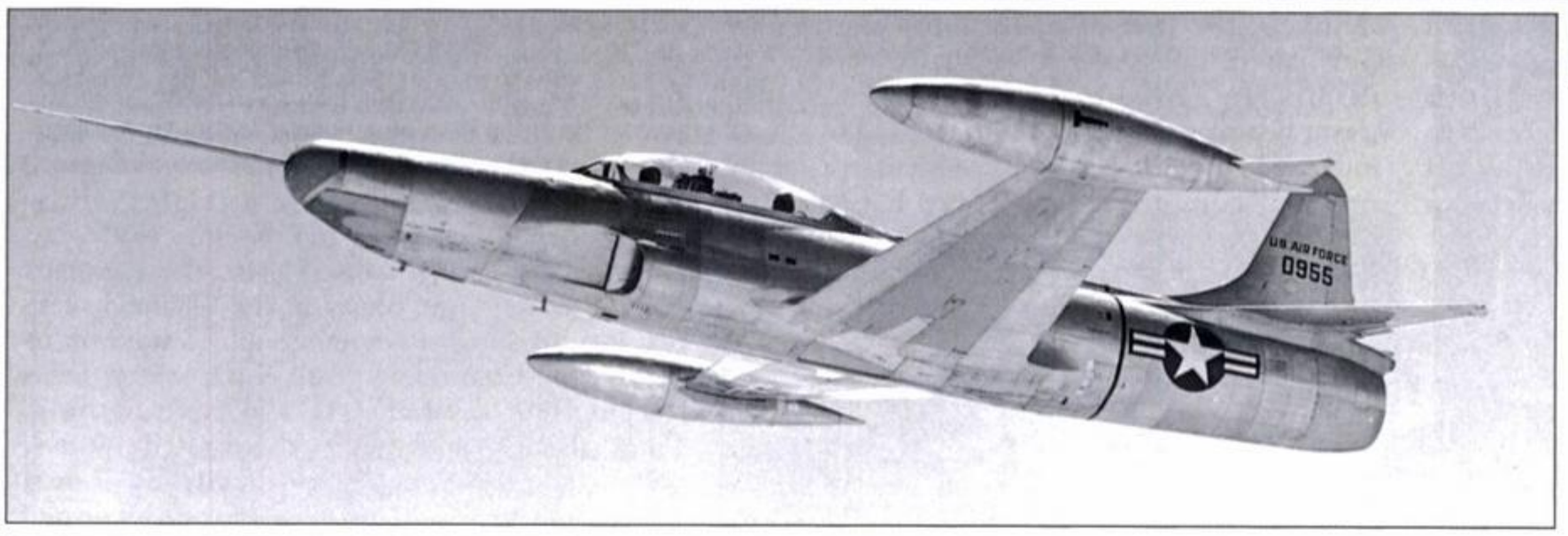
YF-97

The YF-97 designation refers to two prototypes for the eventual production F-94C, the first of which was known at first only as the company model L-188. Initially snubbed by the Air Force in its efforts to improve the F-94A/B design (though the service was readily purchasing the North American F-86D Sabre and Northrop F-89A Scorpion), Lockheed created a company-funded civil demonstrator aircraft which it called the L-188 (and, confusingly, in some documents, the 'F-94B'). This company 'dogship' was meant to test some of the elements of the new interceptor that Lockheed wanted to build, including nose-mounted, all-rocket armament (not fitted on the demonstrator), a Pratt & Whitney J48 afterburning turbojet which was a licence-built development of the Rolls-Royce Tay (this demonstrator used a British-built Tay without afterburner), and Hughes E-5 fire control system with APG-40 radar (also not initially fitted). This aircraft tested the swept horizontal tail surface that became standard on the F-94C but did not have the latter's distinctive air intakes.

This civilian demonstrator, registered N34C, completed its maiden flight on 19 January 1950 at Van Nuys Airport, piloted by Tony LeVier. After it had been flying for some time, the Air Force purchased it as the YF-97A and belatedly assigned military serial 50-955. The USAF then ordered a fully-equipped service-test YF-97 (50-877) with E-5 fire control system and rocket armament. This example was manufactured with the Pratt & Whitney J48-P-3 turbojet with afterburner, rated at 3,000 lb (13.34 kN) thrust without augmentation and 5,000 lb (22.24 kN) when afterburner was applied.

The two prototypes were redesignated YF-94C on 12 September 1950.

The last of 151 F-94Bs built (50-955) was reworked by Lockheed, originally with a non-afterburning Rolls-Royce Tay installed and a new swept tailplane fitted, but without the new radar and armament intended for the F-97/F-94C. It was then re-engined with a J48-P-5 with afterburner, as seen here. During development, Lockheed experimented with a variety of different tip tank designs, of varying size and shape, in an attempt to improve the aircraft's fuel capacity and range. The pair seen on this aircraft resemble those fitted to the Republic F-84 Thunderjet.



F-97A

The F-97A (Lockheed Model 880-75-13) was the initial designation for the F-94C model. The term F-97 was used extensively in early correspondence and was the last real fighter designation before the supersonic 'Century Series' of fighters was launched with the F-100 Super Sabre. (The designations F-98 and F-99 went to the Hughes Falcon and Boeing BOMARC missiles.) Before a first flight could take place, the F-97A was redesignated F-94C, on 12 September 1950. Some 387 aircraft were completed and flown as the F-94C.

L-204

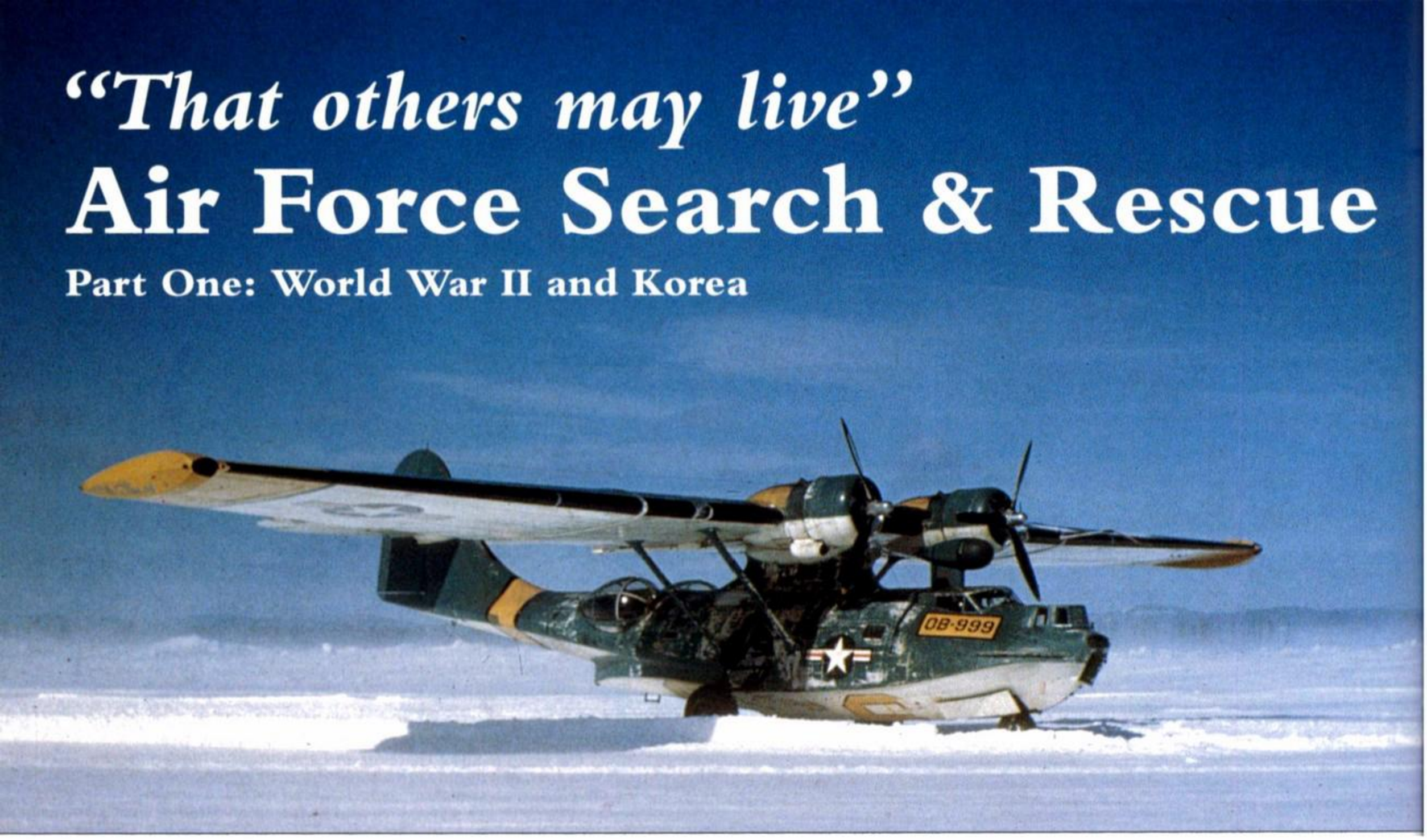
Lockheed L-204 was the company designation for an unbuilt development of the F-94C that would have significantly altered the appearance of the aircraft and introduced numerous new systems. The three sub-variants in this series all retained the all-rocket armament, Hughes E-5 fire control system, and J48-P-5 engine found on the F-94C. All would have carried additional fuel and would have been configured for a single pilot.

The L-204-1 would have introduced a variable-sweep wing that could be changed in flight from 0° to 55°, rooted in an enormous box from which it protruded like the blade of a jack-knife. The span of the wing varied from 37 ft 6 in (11.43 m) at 0° sweep to 25 ft 3.5 in (7.71 m) at 55°. With a maximum take-off weight of 22,166 lb (10054 kg) and a service ceiling of 50,000 ft (15240 m), the L-204-1 would have been capable of supersonic speed in level flight.

The L-204-2 dispensed with the variable-sweep wing but introduced more internal fuel and equipment. At a projected maximum take-off weight of 24,098 lb (10930 kg), the L-204-2 was the heaviest aircraft in this series.

The L-204-3 had a somewhat different tail configuration and less fuel, and was about 12 per cent lighter. All three variants in the Lockheed L-204 series remained very much in the study phase. By 1953, the USAF was well advanced with its work on the F-102 Delta Dagger and F-106 Delta Dart, and saw no reason to prolong the life of the much-admired but limited F-94 series.

"That others may live"
Air Force Search & Rescue
Part One: World War II and Korea



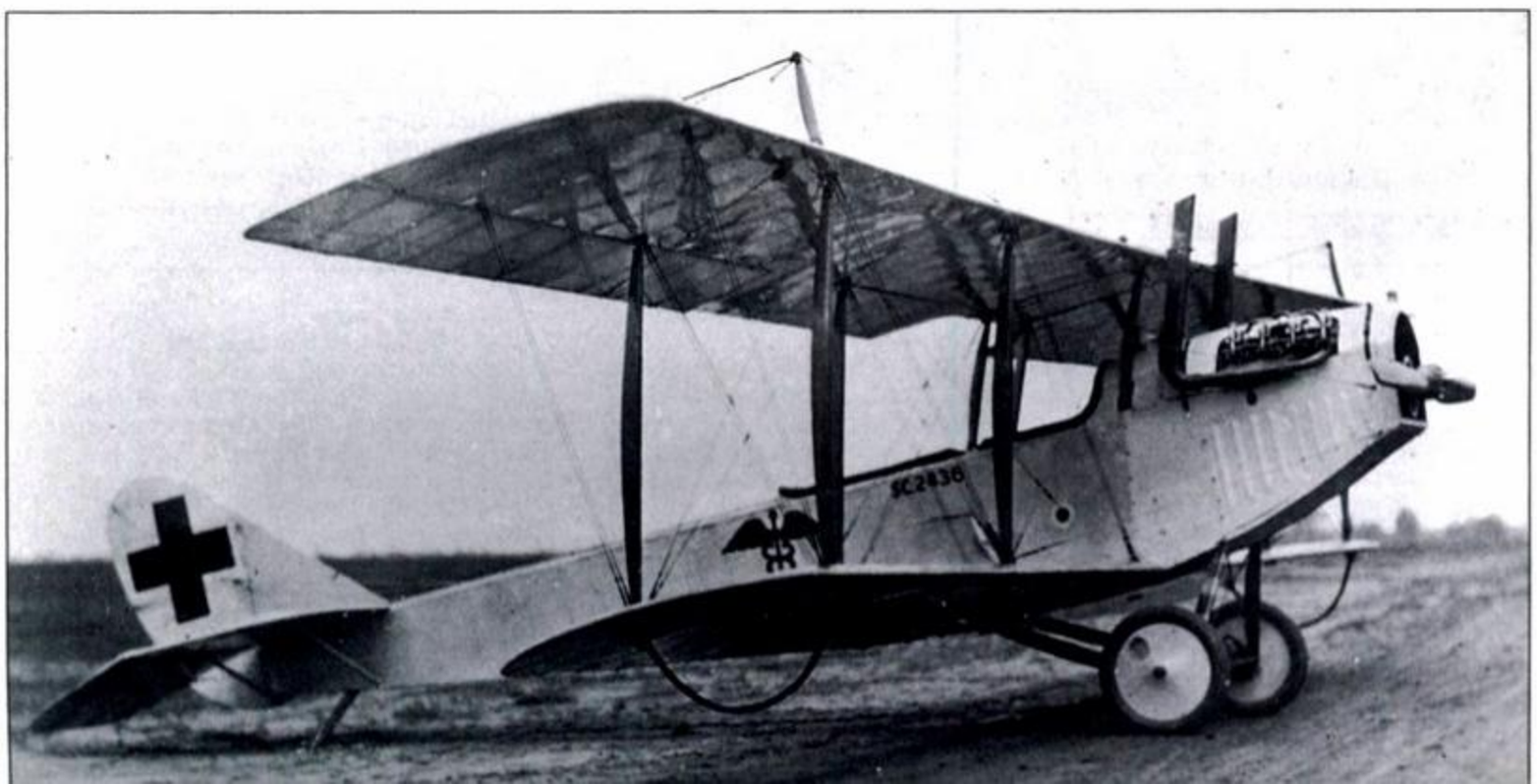
The code of the air rescueman: "It is my duty, as a member of the Air Rescue Service, to save life and to aid the injured. I will be prepared at all times to perform my assigned duties quickly and efficiently, placing these duties before personal desires and comforts. These things I do that others may live."

Catalinas, OA-10As in USAAF/USAF service (SA-10As after 1948), bore the brunt of the air-sea rescue task during World War II. This Air Force Catalina sits on the snow-covered ramp at Goose Bay AB, Labrador during the late 1940s. By this date, the SA-10 had the new medium blue paint scheme, with yellow markings on the wingtips, tail and the top of the wing centre-section.

The USAF Air Rescue Service motto 'That Others May Live' could easily be the motto for all rescue units around the world, no matter to which nation or which service they belong. These unselfish individuals rarely get, nor do they seek, glory. They may be pararescuemen, helicopter pilots, firefighters, medics, etc. – their mission is to put their lives on the line in order to ensure the lives and safety of others.

The aerial rescue mission has been around almost as long as man has been able to fly. The first aerial rescue came as early as 1870, when French balloonists airlifted injured military and civilian personnel from Paris during the Franco-Prussian War. It was during World War I that the first 'flying ambulances' were tested by the US Army Air Corps, using a modified JN-4 Jenny that could accommodate a single litter in the rear fuselage. World War II saw the emergence of the first organised air rescue units. The Germans realised very early in the Battle of Britain that some type of air rescue unit would be necessary for the Luftwaffe to be victorious. The Luftwaffe pilots needed reassurance that they would not be left to their own devices if they were shot down over the English Channel. Aircraft could be replaced, but highly trained, veteran pilots could not.

When Hitler began his campaign to force England to its knees through the use of aerial bombardment, he moved major forces to Western Europe. Along with the many squadrons of Messerschmitts, Junkers and Heinkels, the first of many units of the new German rescue service (actually created in 1938) were moved to bases near the Channel. Using floatplanes such as the Heinkel He 59C-2 and Arado Ar 196 *seenotflugzeug* (air-sea rescue aircraft), combined with Navy E-boats, the German rescue service pulled many Luftwaffe and RAF pilots from the cold waters of the Channel and the North Sea. These aircraft were marked with large red crosses, the universal symbol for hope, so they would be quickly identified as a rescue unit, not a combatant. However, the Germans soon began using the rescue aircraft also as spotters, calling out the positions of British shipping to waiting Luftwaffe bombers or U-boats. The British soon sent a message to the German commanders, warning that, if this continued, the aircraft would be shot down.



Among the first American 'rescue' types were a number of Curtiss JN-4 Jennies, modified to carry a single litter and tested by the USAAC during World War I.

German developments

It was also the Germans who developed several of the more prominent air rescue tools that were used by both sides throughout the war. The inflatable one-man dinghy, fluorescein dye markers to make a downed airman more visible to patrolling rescue aircraft, yellow colouring for life jackets and dinghies – all were German ideas. In October 1940, the Germans began putting large buoys in the Channel. The Sea Rescue Float was big enough to hold up to four men comfortably, with food, water, even sleeping bunks. Both RAF and German crews knew about – and used – these rescue buoys, which were checked periodically by Royal Navy and German Navy vessels for survivors.

The RAF was also losing large numbers of pilots in the air battles over the Channel: well over 200 were lost during July 1940 alone. Very similar in both organisation and equipment to the German air rescue service, the RAF air/sea rescue service was born in August 1940 and was

Above: A P-47D from Detachment B, Flight Section, Headquarters 65th Fighter Wing, sits on the ramp at Boxted in June 1944. Activated on 9 May 1944, Det B P-47s were on five-minute alert whenever a mission was airborne over the Channel or North Sea, both going to, but especially coming back from, 'Target Germany'.

This Army Air Force OA-10A was assigned to the 5th ERS at RAF Halesworth in 1945. The 5th ERS, formed in 1944 at Boxted, was the sole rescue squadron in the 8th Air Force. The OA-10A had just completed delivering a 4th FG pilot back to Debden when this photo was taken.

placed under the operational control of Coastal Command. The RAF rescue units used Lysander and Walrus floatplanes, in conjunction with rescue launches, principally to rescue airmen from training crashes, especially in Scotland.

British ASR success

By the time the United States entered the war and the US Army Air Force's 8th Air Force took its place on hardstands throughout the British Isles, the British air/sea rescue service had evolved into a highly successful unit. In September 1942, the US and England agreed that the 8th AF would use the British air/sea rescue service rather than attempt to organise its own unit, at least initially. At the time, 8th AF had its hands full trying to iron out the many problems associated with daylight precision bombardment, which everyone agreed would never work, so was more than glad to let the British handle the problem of air/sea rescue. On 8 October 1942, the first of thousands of rescues took place when an 8th AF B-17F went down in the Channel near Kent.

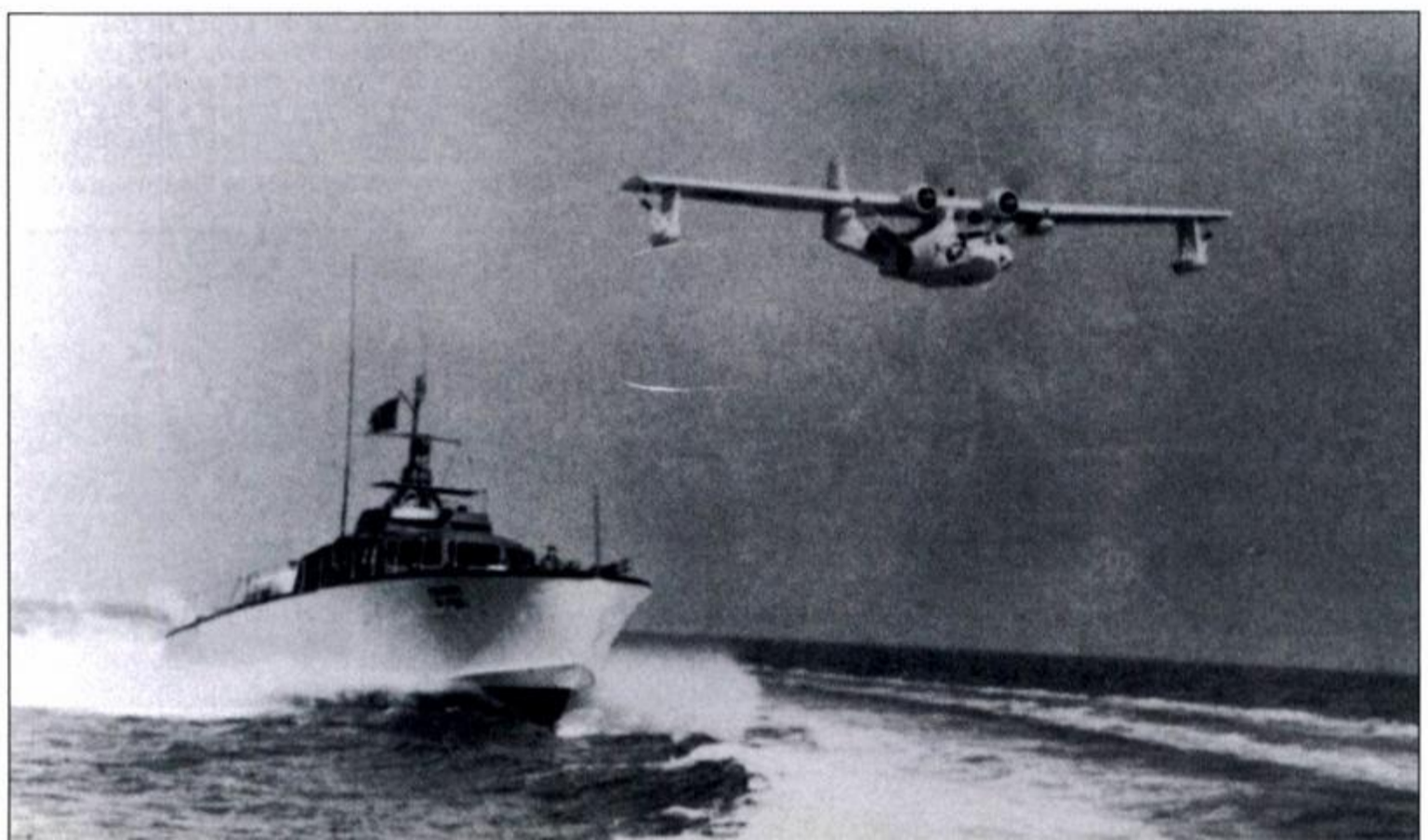
However, the small British rescue force was rapidly overwhelmed attempting to cover both the RAF night raiders and the US 8th AF B-17s that were crossing the Channel at least four times daily. The rescue units were literally working around the clock, with both men and aircraft becoming worn out rather quickly. Any crew forced down in the cold waters of the Channel or the North Sea had to be rescued quickly, lest they die of hypothermia. In 1943, only 28 per cent of the 8th AF crews downed over water were rescued, and the situation became so grave that 8th AF established its own rescue effort late in the year. By spring 1944, with both British and American rescue units operating in the Channel, over 40 per cent of the 8th AF bomber and fighter crews were being picked up.

The 8th AF had a Rescue Control Unit assigned to the 65th FW at Saffron Walden. Initially, the unit simply reported more accurate information about the location of a downed aircraft to the British rescue forces, which would then hasten to the downed crew. In April 1944, 8th AF supplied 25 war-weary P-47s to the rescue effort, modified for the rescue mission with underwing pods that carried air-droppable dinghies plus dye and smoke markers. The unit became operational on 9 May 1944, being designated Detachment B, Flight Section, Headquarters 65th FW, and by then based at Boxted. The detachment was organised as a full squadron in January 1945 – the 5th Emergency Rescue Squadron. It still flew old, war-weary P-47Ds but, being at Boxted, home of the renowned 56th FG 'Zemke's Wolfpack', the ground crews of the 5th ERS could beg, borrow and often steal whatever they needed to keep their aircraft flying. The 5th ERS began receiving OA-10A Catalinas in late 1944, and B-17Hs before the end of the war, which greatly expanded the scope of their operations.

By late 1944, almost 90 per cent of all 8th AF, 9th AF and Bomber Command crews forced down at sea were being rescued. Flying about 750 hours each month, the 5th ERS was

Right: One of the 8th AF rescue boats is seen tied up at Portsmouth. The rescue boats worked in conjunction with the aircraft of the 5th ERS at Boxted and the RAF air-sea rescue service. By 1945, AAF Emergency Boat Squadrons were based on both sides of the Channel. The Higgins rescue boats had 37-mm anti-aircraft guns on the foredeck, plus multiple 0.50-in guns for air defence.

In the later war years, the USAAF Air Rescue Service was organised around a Consolidated OA-10A Catalina rescue flight, and an Emergency Boat Squadron that was equipped with Higgins high-speed launches, which were usually modified motor torpedo boats with rescue equipment instead of the standard torpedo tubes. Powered by a trio of V-1650 Merlin engines, these crash boats were capable of speeds in excess of 60 kt (69 mph; 111 km/h).



Search & Rescue

Brigadier General Nathan Twining, commander of 13th Air Force, crashed in his B-17 off the New Hebrides on 27 January 1943. Twining and his crew of 14 were in the water for five days and six nights before being picked up by a Navy PBY Catalina. This rescue is credited with the ultimate formation of an Army Emergency Rescue School at Keesler Field, Mississippi. According to the official USAAF caption for the far right photograph, "their food comprised chocolate candy, half a sardine per person each second and fifth day, and a partially digested hors d'oeuvre provided by an albatross shot by the general."

responsible for rescuing about 50 men per month. By the end of the war in Europe, over 6,000 crew members had been picked from the home waters around England. Another 300-plus Germans were pulled from the Channel, although their fate was to go directly from the Channel to a POW camp – but at least it was warm and dry.

In the Mediterranean theatre, air/sea rescue was even more critical to both sides than it was over the Channel, due to the vast distances involved between Allied air bases in North Africa and their targets in southern Europe. Even though the war in Africa had been ongoing since 1941, it was not until February 1943 that the first operational air/sea rescue unit was formed – No. 283 Air/Sea Rescue Squadron. Based at La Sebala, Tunisia, No. 283 Sqn was equipped with Walrus floatplanes and high-speed rescue launches. By mid-1944, the British air/sea rescue effort had grown to four squadrons in both North Africa and on the islands around Sicily.

First air/sea rescue 'Cats'

The American effort in the Mediterranean was haphazard at best, but it was a beginning, and marked the first use of Army OA-10A Catalina flying-boats for the air/sea rescue mission. Five OA-10s were dispatched to the Mediterranean in mid-1943, directly from the training base in Florida. However, the aircraft were in such poor shape that only three finished the Atlantic crossing. Undaunted, in spite of the many problems with poor aircraft, no squadron organisation or maintenance facilities, the fledgling air rescue unit flew its first mission on 17 July 1943. An RAF Hurricane pilot who had been adrift in the Mediterranean for eight days was rescued.

Having performed 56 rescues during the last six months of 1943, this small detachment went back to the United States, where it formed the cadre for the Army Air Force Emergency Rescue School formed at Keesler Field, Mississippi. The first squadron created from the initial graduating class at Keesler was the 1st ERS, activated at Boca Raton, Florida in October 1943. Training at Keesler was completed in January 1944, and the unit departed for Casablanca in February. The 1st ERS was equipped with nine OA-10 Catalinas, two Stinson L-5s and three North American B-25G Mitchell bombers. The 1st ERS was operational at Ajaccio, Corsica in April, with aircrews working in conjunction with the four Army emergency boat units operating in the theatre. The 1st ERS was awarded the Presidential Unit Citation for its work during the invasion of southern France in August 1944.

The AAF rescue effort in the Pacific theatre was many times more arduous than either of the European efforts. The vast expanses of the Pacific, and the fact that the Japanese controlled most of the area, made air rescue a primary problem with relation to any and all air operations, be it Navy or Army. The Navy had its PBY 'Black Cat' squadrons which were also used for both long-range patrol and anti-shipping missions, but the Army had nothing in the way of an air-sea rescue aircraft until mid-1943. In July 1943, Major John Small of 5th AF Fighter Command took it upon himself to organise the air rescue mission in the area of 5th AF operations. With a single enlisted man and himself, Major Small began directing air searches for downed 5th AF crews. He had to use Navy resources for the actual rescues, as no aircraft were assigned to the mission. In late August 1943, the first four OA-10 Catalinas were delivered to Major Small.

His cause had been helped immeasurably when Brigadier General Nathan Twining, CO of 13th AF, was downed somewhere between Guadalcanal and Espirito Santo in January 1943. A Navy PBY finally found General Twining and his crew after they spent six days in life rafts off the New Hebrides Islands. The rescue of General Twining by Navy PBYs had led directly to the formation of the Army Emergency Rescue School.

The first pre-formed unit to graduate the school was the 2nd ERS, which had been formed prior to its training period at Keesler; it was operational from Biak on 17 July 1944. All of Major Small's 5th AF contingent, both men and aircraft, had been transferred to the 2nd

Left: An Army Air Force OA-10A Catalina is serviced in North Africa in early 1944. The over-sized national insignia has had the red surround over-painted with dark blue.

Below: With a Stinson L-5 overhead, a USAAF Catalina rests on an airstrip on Leyte in the Philippine Islands in late 1944/early 1945. Attached to the 475th Fighter Group, the aircraft provided SAR support for the group's P-38s. Note the underwing long-range fuel tanks and ASV radar aerials.

Left: An OA-10A of the 5th Rescue Squadron is seen at its base at Foggia, Italy in February 1945. The 5th RS was responsible for the northern sector of the Mediterranean Sea. These Army Air Force OA-10As were painted dark blue and white, a scheme that rapidly oxidised and faded in the hot Mediterranean sun.

Above: This R-4B Hoverfly was equipped with pontoons for water landings. Experimentally assigned to the 4th Rescue Squadron on Tinian in 1945, the R-4 could retrieve B-29 crew members from the waters of the Pacific out to a radius of 65 miles from Tinian and Saipan.

The Sikorsky YR-4 went to the China-Burma-India theatre in the spring of 1945 for testing as a rescue aircraft. Assigned to the 8th RS, the YR-4s recovered some 110 personnel before the end of the war. With a combat radius of only 65 miles (105 km), it was necessary to transport the helicopters to a forward operating location by C-46 and C-47. The YR-4 was then re-assembled and flown to the target area to recover the downed airmen or trapped soldiers.

ERS in the late summer of 1944. By September, the 2nd had 20 OA-10As in its inventory, forming four flights; by 1945, the unit had saved over 500 men.

By spring 1945, the Army Air Force had enough trained personnel and OA-10As to form two complete rescue groups, the 5th Rescue Composite Group (originally designated the 527th RCG) and the 13th RCG (originally designated the 5230th RCG). Each group was made up of at least one squadron of OA-10As and one emergency boat squadron (EBS). The 13th RCG comprised the 2nd ERS and 15th EBS, while the 5th RCG had the 3rd and 6th ERS, plus the 14th EBS, assigned. By late 1944, there were sufficient air rescue personnel and aircraft that the rescue groups were considered an integral part of every operations plan, both AAF and Navy/Marine. By the end of the war, 5th AF air rescue units had saved 1,841 men, including over half of the B-29 crews who ditched between the Marianas and their targets in Japan.

Most of the rescue effort in the China-Burma-India theatre was carried out by RAF units. A small AAF contingent of three Vickers-built OA-10s was dissolved in 1945 when one of its three aircraft crashed. In early 1945, two flights were transferred from the 1st ERS in Italy to form the 7th ERS, which became operational on 25 January 1945 at Tingkawk, India.

The first true AAF rescue units that could perform both rescue and medical evacuation duties was formed in the CBI theatre. This small, elite unit of medical and survival specialists operated from Chabua, India. The team would first locate the crash site using light planes like the Stinson L-5, then march overland to recover any survivors, administering medical aid to injured personnel along the way. It was a long and hard way to perform the rescue mission, but would soon be alleviated greatly by a brand new aircraft type – the helicopter.

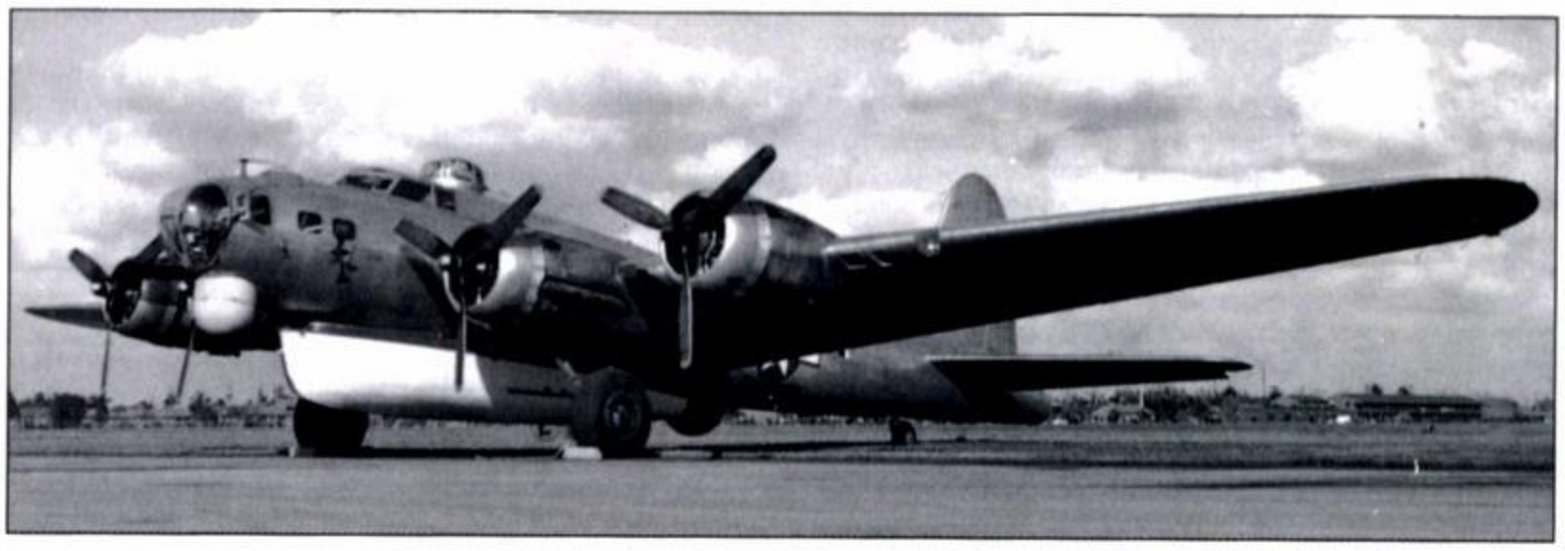
Rotary wings in CBI

The CBI theatre saw the first use of rotary-winged aircraft for the rescue mission. In May 1945, the 8th ERS began operations using Sikorsky R-4 and R-6 Hoverfly helicopters. The 8th ERS used a C-47 to locate the crash site, then moved the helicopters to a forward location for the actual recovery. By the end of the war, the 8th ERS helicopters had rescued 43 men from the jungles of Southeast Asia; this would be a common occurrence in a war some 20 years later over the same terrain.

The R-4 had a crew of two and was powered by a 200-hp (150-kW) Warner R-550-3 engine. Many of the aircraft sent to the CBI were YR-4B service test helicopters, with a top speed of about 82 mph (132 km/h) and a 130-mile (210-km) range. The R-6, a redesigned version of the R-4, featured a more aerodynamic fuselage and a much more powerful engine. The production version of the R-6 was built by Nash-Kelvinator, and had a Franklin O-405-9 engine capable of 240 hp (180 kW), offering a top speed of more than 105 mph (170 km/h). Nash built a total of 219 YR-6A/R-6A Hoverflies for both the AAF and the Navy.

By the end of the war, the AAF air rescue

A new B-17H is seen on the ramp at an Army airfield in 1945. The B-17H had the type A-1 air-droppable rescue boat installed under the bomb bay area, which was then filled with additional fuel tanks and rescue supplies. The chin turret was replaced with an ASV radar set.



Below: A B-17H from the 2nd Rescue Squadron sits on the ramp at Zamboanga in mid-1945. The B-17H with the A-1 rescue boat installed had a range of over 3,500 miles (5633 km). B-17Hs and OA-10A Catalina amphibians were assigned to the 2nd RS during the later months of World War II.

Below: Lt James Posten, a 9th Fighter Squadron P-38J pilot, was lucky that his Lightning went down close to the shore of New Guinea in late 1944. One of the EBS crash boats is seen leaving the area, since the pilot could walk ashore from his downed aircraft.

OA-10A 44-34075, 'Playmate 97', poses with its crew – from left to right, John Ree, John Hickey, Fred Howell, Richard Millard, Charles Oates, Walter Harold, and Harold Peterson.

"Let's go in – this is what we were trained for ..."

On the morning of 13 August 1945, the crew of OA-10A 44-34075, using the codename 'Playmate 97', left Iwo Jima for a mission to the Tokyo Bay area of Japan. The mission was to cover strikes against the mainland by aircraft from the 3rd and 5th Fleet. The crew consisted of First Lieutenant Charles Oates – pilot, Second Lieutenant John Ree – co-pilot, Second Lieutenant Richard Millard – navigator, Sergeant John Hickey – engineer, Sergeant Walter Harold – radio, Sergeant Fred Howell – radar operator, Corporal Harold Peterson – medical technician, and Private First Class Vincent Roden – mechanic. Roden was on the flight to get his monthly flying time and normally was not part of the crew.

Arriving on-station, about 2 miles (3.2 km) outside the entrance to Tokyo Bay, at about 13.00, Ree received a coded radio message that three men were down and floating in rafts. Ree gave the message to Millard to decode the location of the downed airmen. It was inside Tokyo Bay. Millard thought it was an error and requested the message be repeated. Again, the location was the same. Ree was flying the left seat as pilot on this mission, as pilots often switched roles. When Oates and Ree were told of the location of the downed airmen, Oates asked Ree, "Well, what do you think?" Ree responded, "Let's go in – this is what we were trained for." They called on the radio to request some fighter cover, and two Navy Hellcats were assigned to CAP the rescue. In they went.

The three men in the bay were Ensigns John Brega, Ralph Warehime and Norman Proudfit, the crew of a Navy TBM Avenger torpedo-bomber from the USS *Ticonderoga*. Brega's TBM was downed after dropping its bombs and leaving the target. A very close burst of flak forced their Avenger into the path of a second TBM that was attempting to join on Brega's wing for the flight home. The prop of the other TBM cut off the tail section of Brega's aircraft, forcing Brega and his crew to bail out.

They had landed in the water amid a dense layer of fog, uncertain of their exact location. After finding and joining with each other, they tied their rafts together so they would not drift apart. This made them three times as big a target to be seen by a rescue aircraft – and by the Japanese on shore. The wait began. They did not know if anyone knew they were down, or where they were, and they did not know if anyone was coming for them. It was not long before the fog started to lift and they could see the shoreline. They were smack dab in the middle of Tokyo Bay!

During the long wait, they could see Japanese fighters taking off and landing at a nearby airfield. Occasionally, the enemy fighters would fly overhead and the three Navy airmen would jump into the water and hide under the rafts. They were also concerned that the emergency dye marker, used to highlight their location to any rescue aircraft nearby, would remain contained and not spread. To make matters worse, several playful porpoises began to bump and push the rafts toward the shore – the very last place the three men wanted to go!

After spending almost seven hours in the water, Brega and his crew suddenly heard aircraft engines, followed by a tremendous amount of flak exploding in the air. At first, they thought it might be another air strike in progress. But no – lo and behold, it was a big, beautiful PBY 'Dumbo'.

Oates and Ree decided that the best approach to the bay would be over the entrance between the two peninsulas jutting from either side, not knowing a heavy concentration of anti-aircraft guns was located there. Flying at 4,000 ft (1220 m), they received some heavy flak just as they approached the entrance to the bay. Oates left the flight deck to go aft to locate and bring forward their parachutes. Being very uncomfortable, they were not normally worn on routine missions.

Meanwhile, Ree was flying through the flak by skidding the big flying-boat right and left, up and down – anything except flying a straight line, to prevent the flak guns getting a track on their flight path. The noise from the flak was like being inside a steel drum while someone beat on the outside with a hammer. At one point, Ree looked outside and saw a shell leave an anti-aircraft gun. He was amazed that he could follow its path up to the aircraft. Fortunately, the shell exploded behind the them.

Once they were past the entrance, the anti-aircraft fire ceased. Ree immediately spotted the three downed airmen. He was already descending from 4,000 ft and starting an approach to land the big Catalina when Oates returned to the flight deck with the 'chutes, which the crew immediately put on. Their approach was a little high, but they touched down even with, and almost on top of, the airmen in their rafts. The Catalina bounced three times, running past the rafts. Immediately upon touching down, they received a burst of machine-gun fire right across the bow from an unknown source. Ree and Oates assumed the escorting Navy Hellcats would take care of the problem.

After they turned around and started to taxi back to the rafts, the shore batteries again opened fire. Flak started splashing all around the aircraft. Simultaneously, a Japanese destroyer came out from Yokosuka naval base and headed right for them. As the Catalina approached the rafts, the destroyer started firing. When they reached the men, who were already in the water and waiting to be picked up, the aircraft's left engine was shut down so the propeller would not endanger them while they were picked out of the sea through the left gun blister. Unfortunately, two men were on the left side, while the third was on the right, and the Catalina had to be turned around to pick up the third.

Meanwhile, the destroyer was rapidly closing on the rescue scene, and was firing all the time. Ree was trying to dump some fuel to lighten the load for the take-off, with little success, when one of the destroyer's shells exploded under the right wing. It splashed water through the right blister and into the aircraft, knocking Peterson, the medic, off his feet. After 13 minutes on the water, they had had enough, and immediately commenced the take-off run. Just as they started the run, a shell hit the middle of the empty rafts, and one of the men in back was heard to yell, "There go the rafts!"

But the big 'Cat' was still moving, and seemingly unhurt. Ree pulled the controls back and it lifted off the water. After becoming airborne, they climbed in circles directly over the centre of Tokyo Bay to an altitude of about 9,000 ft (2745 m). They headed out of the bay following the same route they had taken entering it. Again, they had to run the gauntlet of flak near the entrance; and, again, they made it through. Three men rescued, safe and sound. They radioed that the rescue was successful, and headed for Iwo with three survivors.

Brega and his crew were flown to Iwo from where, after a few days, the Navy transported them back to the *Ticonderoga*. By then the war was over, and they did not have to worry about risking another experience like the one they had just been through.

Shortly after landing, Ree received a message from Admiral William F. 'Bull' Halsey, saying, "Congratulations and Well Done!" As a result of the mission, Charles Oates, USAAF, was awarded the Navy Cross; John Ree and Richard Millard, USAAF, were recommended for the Silver Star and were awarded the Navy Distinguished Flying Cross; Sergeants Hickey, Harold and Howell, Corporal Peterson and Private First Class Roden were all recommended for the Bronze Star and were awarded the Navy Distinguished Flying Cross.

The story does not end there. Shortly after 'Playmate 97' had successfully rescued Brega and his crew and were en route to Iwo Jima, well clear of Tokyo Bay, a second OA-10A, 'Playmate 96' arrived on-station to take their place. 'Playmate 96', flown by First Lieutenant Eliason, entered Tokyo Bay to rescue an additional two survivors, possibly from the other TBM involved in the collision with Brega's aircraft. As Oates and his crew were departing the area, they heard a frantic call from 'Playmate 96': Eliason was calling for help as he was being attacked by Japanese fighters. A short while later, a patrolling aircraft reported that wreckage was sighted near the southeast shore of Tokyo Bay. It was presumed to be 'Playmate 96', and there were no survivors.

Questions abounded. Were there actually two additional men down in Tokyo Bay? The Navy had no record of them. Were all three of Brega's rafts sunk by the shelling from the Japanese destroyer? It is unlikely that a single shell would sink all three separate life rafts. Did another aircraft report two additional men down based on sighting the two empty life rafts? Possibly. Did Eliason land next to the empty rafts, then take off again? Possibly. Nothing can be proved, since Eliason and his crew were all lost on the mission.

First Lieutenant Yutaka Morioka, Japanese navy pilot and flight leader, was one of the pilots involved in the shoot-down of the Catalina that day. He recalls, "On 13 August 1945, we eight Zeros took off from Atsugi toward Tokyo Bay, where we were ordered to attack US planes invading into the Japanese mainland. When we reached Kujyukuri Beach, there were no enemy planes. They had already invaded Tokyo. I heard the radio from Atsugi, telling me to go to Izu Peninsula, where a US submarine was firing on a lighthouse. We headed southwest alongside Bosoh Peninsula, and just south of Tokyo Bay, the radio cried, 'PBY landed in Tokyo Bay. Attack PBY!'

"At the southern part of Tokyo Bay, I found a white PBY flying south on my front. It seemed to be not long after take-off, because its position was not high off the water. We rushed to the PBY, shooting my 20-mm guns in a frontal attack. Its left engine began to draw black smoke. I had observed this brave flying-boat as it was shooting small guns toward us. We made another frontal attack and it turned, left side burning, and crashed into the sea near Tateyama City.

"No F6Fs nor other PBYs were found there while we attacked. After downing the PBY, we ran away as I knew that F6Fs would immediately be summoned by emergency radio."

Speaking to John Ree in 1990, Morioka said, "You were very lucky. If we'd reached there a little earlier, I probably would have found you and your PBY would have been attacked by my eight Zero fighters. The result would have been the same. I learned that the pilot was First Lieutenant Eliason, and that eight crewmen and two rescued pilots were killed. Now I say a mass for the crew of the downed PBY."

2nd Lt John Ree, 'Playmate 97',
4th Emergency Rescue Squadron

I'll Be Seein' You, ***an Army Air Force Vickers OA-10A from the 6th Emergency Rescue Squadron, sits on the Ie Shima ramp in 1945. The Pacific-based OA-10As were usually painted overall white, for easy identification by patrolling AAF and Navy fighters.***

An SB-17G (designated B-17H until 1948) demonstrates the deployment of its type A-1 lifeboat. The basic airframe of the B-17H was that of a late-block B-17G with the Cheyenne tail turret, staggered waist gun positions, and an ASV radome in place of the chin turret.

Above: The ramp at Yokota AB during an inspection of the 2nd Rescue Squadron shows the full complement of search and rescue aircraft assigned to the 2nd RS in 1949. There are six SB-17Gs, a pair of H-5s, one remaining H-6, and three L-5 flying ambulance aircraft.

Right: This 2nd Rescue Squadron SB-17G is seen over the Sea of Japan in 1949, showing the complete air rescue markings authorised during this period. Note that no armament was carried at this time.

units were primarily equipped with the OA-10A Catalina amphibian flying-boats, built by both Consolidated-Vultee and Vickers (Canada). Squadrons were also equipped with converted bomber types, such as the SB-17 and the SB-29, which carried the Higgins type A-1 lifeboat under the fuselage. The A-1 was 27 ft (8.2 m) long and was built to withstand both 40-mph (64-km/h) winds and 20-ft (6-m) waves, and was equipped with clothing, food and water for up to 12 persons, about 20 days worth. It was powered by two air-cooled engines that gave it a cruising speed of 8 kt (9 mph; 15 km/h), with a range of up to 500 miles (805 km).

Few people realise that both the US Army Air Force and the US Air Force were in the navy business well into the 1950s. Emergency boat squadrons were formed in early 1943. Initially trained by US Navy crews, the EBS crews were later trained at the AAF Emergency Rescue School at Keesler Field. The AAF EBS units used various types of watercraft, from swamp buggies to converted torpedo boats to small ocean-going ships similar to a Coast Guard cutter. Eventually, a modified 85-ft (26-m) torpedo boat was developed and standardised for the EBS mission.

The 'Gibson Girl'

The most important development for the rescue mission was the small, portable radio – the SCR-578, commonly called the 'Gibson Girl'. Installed in the larger lifeboat types, the SCR-578 had its own hand-powered generator, operating over two frequencies, with a range of 200 to 300 miles (320 to 480 km) on the low band. On the high band (8280 kilocycles), the range increased to 1,500 miles (2415 km) under optimum conditions.

On 13 March 1946, Headquarters Air Rescue Service was established under the control of Air Transport Command. It had evolved from a simple unit under the Director of Traffic Control and Regulations, via the Emergency Rescue Branch in August 1943, to the Air-Sea Rescue Agency in February 1944, before finally becoming a true independent branch of the Army Air Force in 1946 – the Air Rescue Service. With a high strength of seven squadrons in late 1945, by 1946 the Air Rescue Service was made up of Headquarters ARS, two squadrons and 10 detachments at bases around the continental United States. The aircraft inventory included 33 C/SC-47 Skytrains, 13 B-17Hs and 12 OA-10A Catalinas, for the long-range air-sea rescue mission. For short-range, overland missions, there were 32 Stinson L-5s used as flying ambulances, 17 Sikorsky R-5 Dragonflies, and a few remaining R-6s.

Between 1946 and the beginning of the Korean War, the Air Rescue Service performed a variety of non-typical missions. In Operation Container Missile, many ARS units dropped containers of water or extinguishing agent to beleaguered US Forestry Service fire-fighters working throughout the southwest. In July 1946, ARS helicopters were used to transport mail in Los Angeles and Chicago. That same month, Headquarters ARS moved from Washington National Airport to Morrison Field, Florida.

ARS crews were also kept busy doing the things they were trained to do – acts of mercy. They were rushed to Bolivia in February 1947 to supply flood relief to that nation. ARS aircraft and helicopters were pressed into service dropping supplies to US civilians during the 1949 blizzard that paralysed the western United States. ARS SC-47s and C-82 Packets dropped food, fuel, coal and cattle feed into the snow-covered areas.

In January 1948, ARS began deploying flights to bases around the globe, from Goose Bay, Labrador to the Azores, from Wheelus Field, Libya to Dhahran Airport, Saudi Arabia. The three squadrons in the Far East were brought under the control of the Air Rescue Service on 1 May 1949. Previously, they had either been independent units or assigned to the Far East Air Force (FEAF).

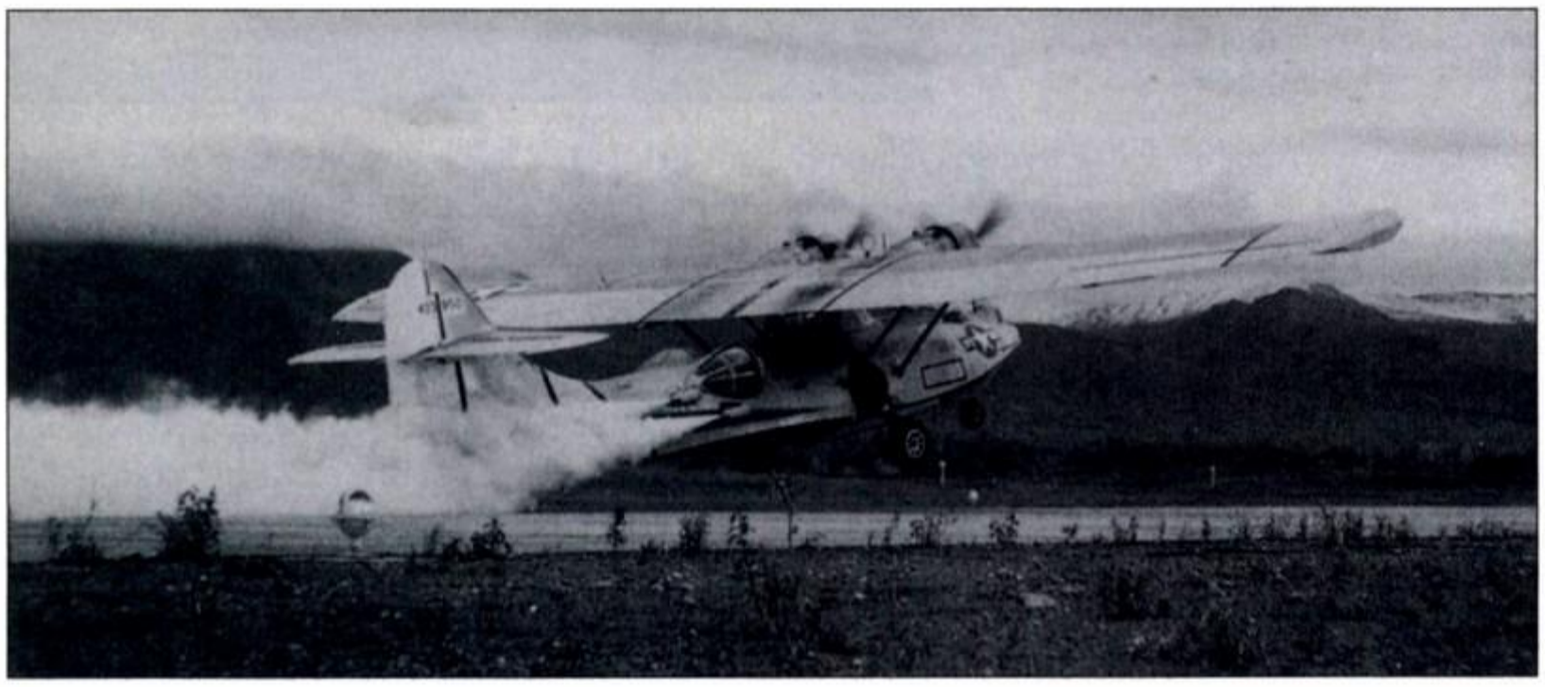
SB-29s enter service

Aircraft inventories increased both in number and quality with the inclusion of the SB-29 from 11 March 1947. The R-5 helicopter became the primary rotary-winged type for both the US Air Force and Navy. In June 1948, the new US Air Force redesignated all helicopters from 'R' for Rotary to 'H' for Helicopter. Thus the R-5 became the H-5. In 1949, the Air Force unveiled the Grumman SA-16 Albatross amphibious aircraft, the replacement for the OA-10A Catalina.

An SB-17G from the 6th Rescue Group is seen on the ramp at Goose AB, Labrador during the early 1950s. This aircraft has both full Arctic markings in Insignia Red, in addition to complete rescue markings in yellow.

A pair of SB-17Gs sits on the ramp at Bluie West One in May 1952, an auxiliary field on Greenland. BW-1 was used as a refuelling stop for transatlantic ferrying flights. The SB-17s would also often lead these flights to their next scheduled stop, as they had better navigational equipment.

An SA-10A from Flight A, 4th Rescue Squadron at March AFB, rescues survivors from a downed aircraft. The Type A-1 lifeboat was dropped to them by an SB-17. The rescue forces worked as a team, with an SB-17 (or SB-29) locating the downed airmen (and dropping a lifeboat), then calling for a pick-up by an SA-10 Catalina or SA-16 Albatross amphibian.



A 10th Rescue Squadron SA-10 uses JATO rockets for a short-field take-off in Alaska. The JATO packs were jettisonable, and often used for take-offs from undeveloped areas that were too short for a normal take-off run. The aircraft designation was changed from OA-10A to SA-10 in 1948.

Sikorsky's H-19 was in production by late 1950. These new aircraft and the crews who would man them were put to the ultimate test beginning in June 1950 – combat rescue in a hostile environment. The Communists were ready to challenge the United Nations.

At 04.00 on the morning of 25 June 1950, the North Korean Communists launched an all-out offensive to militarily reunite the two Koreas under a single flag. It was the start of three years of bloody conflict. President Harry Truman called it a 'police action', but the deaths of more than 54,000 US personnel on that peninsula testify that it truly was a war.

In the Korean War, the rudimentary beginnings of the air rescue team concept were developed, wherein fighter and attack aircraft were integrated with a rescue force to recover trapped soldiers or downed airmen. It did not start out that way, and the very first rescue mission was typical for the ARS at the time – single aircraft, single mission. That first rescue mission occurred on the first day of the fighting, when an SB-17 from the 3rd RS was ordered to Kimpo AB, near Seoul, to deliver Colonel William Wright, commanding the Korean Military Assistance Group, back to his headquarters. The SB-17 was diverted to Pusan when North Korean Air Force Yak fighters strafed Kimpo, destroying a MATS C-54 evacuation plane on the Kimpo ramp.

There were basically two Air Force rescue operations during the Korean War – long-range missions covering the B-29 raids, and short-range ones to pick up downed flyers in or near North Korea. For use in these two vastly different missions, FEAF had two squadrons

SC-47s also served as search aircraft with the ARS post-war. Here an SC-47B of Det 6 formates with a Catalina, some time during 1948.

available – the 2nd RS, with flights in the Philippines and at Kadena, Okinawa; and the 3rd RS, with flights at Yokota, Johnson, Misawa and Ashiya, Japan. The 2nd RS had both SB-17s and SB-29s for the long-range escort of B-29s striking targets throughout North and South Korea. Initially, the 2nd RS at Kadena had Flights C and D equipped with OA-10s, H-5s and SB-17s. As more SB-29s became available during the summer of 1950, the SB-17s were transferred to the 3rd RS. By March 1952, Flight D got the fourth SB-29 and began precautionary escort flights with the B-29 strike forces.

'Super Dumbo'

The SB-29 'Super Dumbo' aircraft were standard B-29A bombers modified for the air rescue mission. The bomb bays were fitted with additional fuel tanks in place of the bomb racks. The lower forward twin-gun turret was replaced by the APQ-13 radar unit, used to locate downed airmen and lifeboats. The Edo Corporation developed the type A-3 lifeboat, a 29-ft 9-in (9.06-m) craft containing food, water, supplies, maps and radios to help the downed airmen. All remaining 0.5-in (12.7-mm) guns were completely operational. The SB-29s would take off before the B-29 strike force. Flying the same mission profile as the strike force, they would orbit well short of the perimeter of the MiG threat, i.e., 'MiG Alley'. As the B-29 force exited North Korea, the SB-29s would take up their escort position, trailing the strike force in the event of an aircraft going down in the Yellow Sea. If a B-29 did go down, the SB-29 was in position to drop the type A-3 lifeboat to the downed airmen, almost before they hit the water. After climbing aboard the lifeboat, the downed crew would await recovery by a US Navy ship, or one of the SA-16 Albatross amphibian aircraft. Almost all overwater emergencies were handled by 2nd RS SB-29s.

Of course, there were many times when the B-29s did not make it out of Korea, either crashing behind enemy lines or being forced down at one of the UN fighter bases in South Korea. In the case of a bail-out over North Korea, the men and aircraft of the 3rd RS would rush to their aid.

The USAF bought 15 Cessna 195s 'off the shelf' in 1949 for evaluation as a light cargo and liaison type with the designation LC-126A. This example, equipped with floats, was assigned to the 10th Rescue Squadron soon after delivery. The 10th RS, at Elmendorf AFB, Alaska was responsible for search and rescue operations in the southern Alaska/ Aleutian Islands areas and inland lakes.

Below: Some 10th RS SC-47Bs were modified for snow operations in the Alaskan tundra by fitting the landing gear with skis.

With fighter missions outnumbering B-29 strikes almost 100:1, it was inevitable that there were far more fighter aircraft downed than B-29s. Only 17 B-29s were 'officially' listed as shot down, but records of the various groups tell a different story. Well over 100 B-29s had sufficient battle damage to cause them to either crash at sea or at a UN air base; some made it back to their home base but were damaged so extensively that they never flew again. Only those aircraft actually shot down over North Korea were listed as 'combat losses'.

Fighter and reconnaissance aircraft missions accounted for 605 aircraft listed as shot down, with a further 704 lost to 'other causes'. The rescue of these crews was the responsibility of the 3rd RS but the job was so immense, and their aircraft and crew strength so low, that the squadron simply could not handle the job. The under-strength 3rd RS had several SB-17Gs, SC-47s and a number of H-5s on inventory. 5th Air Force began transferring additional SB-17s and H-5s, plus crews, from the 2nd RS to the 3rd in early July 1950.

On 22 July 1950, the first contingent of H-5 Dragonflies flew from Ashiya, Japan to Taegu, Korea. The US Army immediately impressed them into service as flying ambulances, transporting wounded GIs from the fighting around Miring and Pusan. In early August, Lieutenant General Earl Partridge, commanding 5th AF, ordered the 3rd RS to transfer six of its nine H-5s to the fighting in Korea. Lieutenant General George Stratemeyer, commanding FEAF, immediately asked for an additional 25 H-5s, but was granted only 14 new aircraft.

In the early summer of 1950, Detachment E of the 5th RS was activated at Lowry AFB, Colorado for duty in the Far East. This brand-new unit was equipped with the brand-new Grumman SA-16 Albatross. Developed for the US Navy as the XJR2F-1, the type made its first flight on 24 October 1947. The Air Force began to order it in 1948 as a replacement for its OA-10A Catalinas, which were now beginning to show their age. The new twin-engined triphibian aircraft, with retractable wheels for land-based operations, was powered by a pair of Wright R-1830 Cyclone engines offering 1,425 hp (1063 kW) each. It was slightly over 60 ft (18 m) long, with a span of 80 ft (24.4 m), and had a top speed of 240 mph (386 km/h) cruising at slightly over 150 mph (240 km/h). Weighing over 30,000 lb (13610 kg), the SA-16 had a maximum range of 2,680 miles (4315 km) when all the internal tanks were full and underwing drop tanks were carried – a total of 1,700 US gal (6435 litres) of fuel. An SA-16 could hold up to 10 passengers, or 12 litters, plus the flight crew of three and a medical technician. Mounts for jet-assisted take-off rocket bottles built into the doors on the aft fuselage allowed the use of JATO at greater take-off weights.

SA-16s enter service

On 28 July 1950, the first four SA-16s arrived at Ashiya AB, Japan. Assigned to the 3rd RS, the Albatross soon made its first rescue: on 4 August 1950, Ensign Glenn Farmworth had to bail out of his crippled F4U Corsair into the Sea of Japan. One of the new SA-16s was scrambled and plucked the lucky pilot from the ocean within 30 minutes of his bail-out.

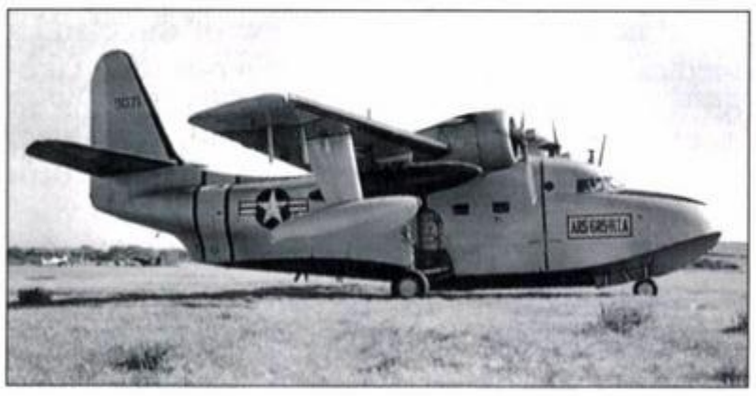
The first mass use of helicopters for the rescue mission was initiated during the Korean War. Several R-4 helicopters had been used in the CBI theatre during the late stages of World

An H-5G with the 10th Rescue Squadron shares the ramp at Ladd AFB with a Waco CG-15A rescue glider. Early rescue helicopter types were painted overall yellow in non-combat areas. This was one of the first 'team effort' rescue units, in which an SC-47 towed the Waco glider, with medics aboard, to the crash site, and the H-5G came in for the pick-up.

An ARS SC-47D flies over Alaska in the early 1950s. The observer's (or scanner's) bubble can be seen just forward of the cargo door. The SC-47, later designated HC-47, would drop the type MA-1 life raft pack then orbit until the survivors were picked up by ship or amphibious aircraft.

This Curtiss C-46D was assigned to the 3rd Rescue Squadron at Yokota AB in 1950. With a longer range and greater payload than the C-47, the Commando was well-suited to the SAR role, but was not used in large numbers and was not officially designated SC-46.

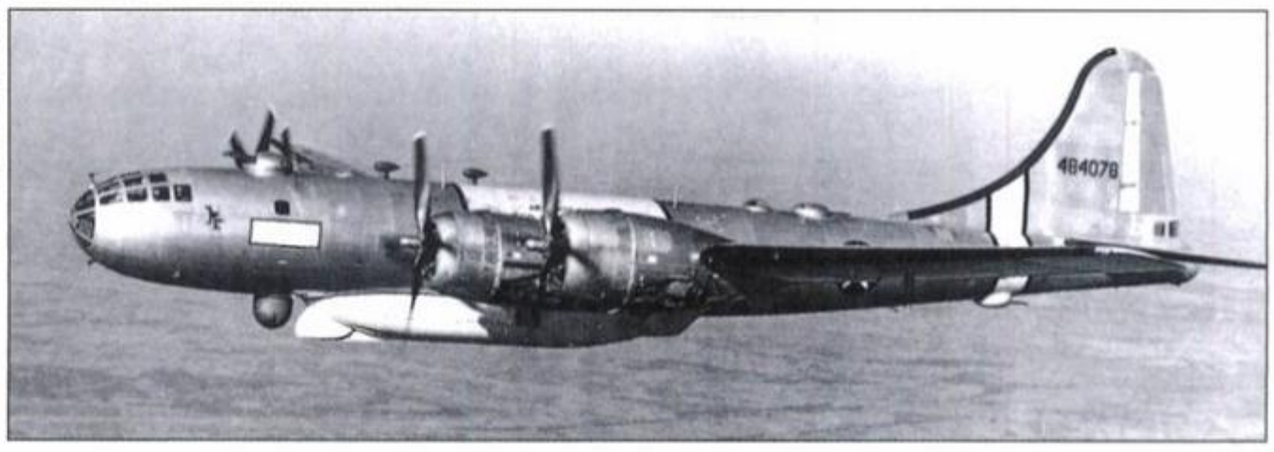
Above: Among the aircraft assigned to the 4th ARS, Detachment 8 at Hamilton AFB in 1948 was this Packet. The long range of the C-82A, coupled with its immense cargo capacity, made it a natural for the rescue mission. However, as they were needed by Troop Carrier Command, only a few were transferred to the Air Rescue Service.



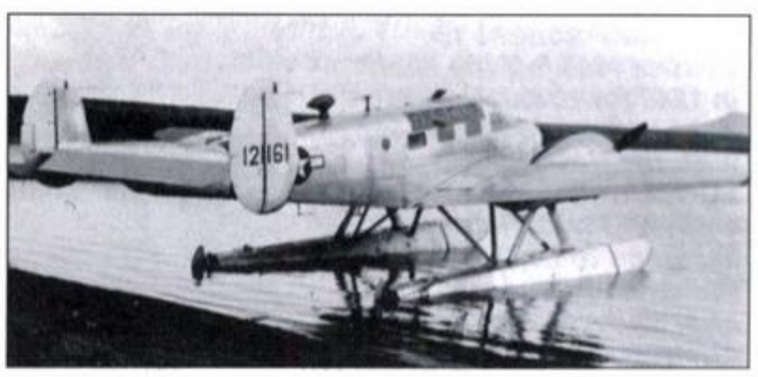
Left: An early production SA-16 Albatross from Flight 'A', 6th RS, is seen without the nose-mounted AN/APS-31A search radar installed. The 6th Rescue Squadron covered the North Atlantic areas from the east coast to Iceland.

Above: On 29 September 1950, five Bermudan fishermen (and a photographer!) adrift in their crippled vessel greet an SB-29A from Flight 'D', 1st ARS, based at Kindley AFB, Bermuda.

Right: A 3rd Rescue Squadron SB-29 is seen over Japan in April 1951. 3rd RS SB-29s escorted the B-29 strikes that originated from Yokota AB, while the 2nd RS covered the Kadena area. Note the A-3 lifeboat and ASV radar under the forward fuselage.



The Army Air Force used large numbers of Stinson L-5s as air ambulances in both World War II and Korea. The rear cabin area was modified to hold a single litter. This aircraft, 42-98633, is painted yellow overall.



The navigational trainer variant of the Beechcraft C-45, the AT-7 entered service in 1941. Six were completed as AT-7As, equipped with floats and assigned to the 10th Rescue Squadron in Alaska during 1945-46.

War II but, though successful, it had been an experimental deployment. Both the 2nd and 3rd RS had flights of H-5s for short-range rescue work, and acting as air ambulances.

Sikorsky's H-5 Dragonfly was a small, single-engined helicopter developed during the late stages of World War II. Originally designated R-5, it had a Pratt & Whitney R-985 radial engine offering 450 hp (335 kW). The H-5 had a two-man crew, sitting tandem – pilot in front and pararescueman in back. Some H-5s were fitted with a winch on the left side, with a long cable and inflatable collar for pick-ups in situations in which the helicopter could not land. The top speed of the H-5 was 93 mph (150 km/h), and the helicopter had a radius of action of 85 miles (136 km). In Korea, the type could carry two litter patients in special racks installed on each side of the cabin.

Naval H-5s

The Navy designated the H-5 as the HO3S, and it was the service's primary rescue helicopter. Prior to every launch, and especially during recovery, a 'plane guard' H-5 was launched, to hover near the ship and pick up any fliers who might end up in the sea. 'Plane guard' H-5s were also used to pluck from the water any crew downed by combat damage – as long as they were within the short range of the H-5. The Navy had several rescue ships, known as 'scows', stationed at strategic points up and down the Korean coasts. These scows were converted tankers and freighters, with H-5s for the rescue mission, whether it was a water or land rescue within North Korea.

By late 1951, the situation in Korea had stabilised to some degree. In December, 3rd RS, Det One sent a pair of H-5s to begin a rescue operation from Chodo Island, which was located about 50 miles (80 km) north of the 38th Parallel, just off the North Korean coast. Chodo was still not secure, though, so the H-5s moved to Paengnyyong-do Island, then staged into Chodo during daylight hours. A small detachment of troops secured Chodo, and Det One's H-5s moved in during January 1952.

In March 1951, the Sikorsky H-19 (S-55) helicopter arrived in Korea. This transport helicopter had a crew of three for the rescue mission, comprising a pilot, co-pilot and medical technician. It was powered by a single Wright R-1300-3 radial engine, giving 800 hp (600 kW). Its maximum speed was only 112 mph (180 km/h), but the range was twice that of the H-5, being 180 miles (290 km).

The H-19 could carry up to 10 walking wounded or eight litters internally, a big improvement over the H-5. The medic could tend to the wounded while en route to the nearest medical facility. A small electric winch attached to the right side of the cabin, just above the co-pilot's (medic's) window, allowed the pilot to pick up people in areas where the helicopter could not land. Some H-19s were equipped with floats, known as 'hot dogs', for water operations.

The first examples deployed to Korea in March 1951 were actually YH-19s from Air Proving Ground Command undertaking combat tests. In February 1952, the first production H-19s entered service with the 3rd RS, Det One. The H-19 replaced the H-5 as rapidly as production would allow, and Det One's crews at Chodo and Paengnyyong-do were

Established in July 1946, HQ Air Rescue Service had two HQ Squadrons – Squadron 'A' at Andrews AFB and Squadron 'B' at Hamilton Field, California, with five detachments at various AFBs around the US. This SB-29A from Squadron 'B' is seen sometime after June 1948.

An SB-29A from the 3rd Rescue Squadron taxis to the active runway at Yokota AB, Japan in 1953. All B-29 strikes over Korea, from either Japan or Okinawa, were escorted by at least one SB-29 'Dumbo', both inbound and outbound from the target.

re-equipped with H-19s in late 1952. However, the supply of H-19s never quite met the demand for the type in Korea. The Army needed H-19s to move men and supplies from one hot spot to another along the Main Line of Resistance (MLR); the Marines had a similar need for the HO4S (the Navy version of the H-19). The Air Force and Navy had made the obsolete H-5 into a successful type for the rescue mission, so their needs for the H-19 as a rescue helicopter came second to those of the Army and Marines.

One of the main differences between the World War II rescue mission and those flown in the Korean War was the organised co-ordination between the various services for the search and rescue (SAR) mission. On 27 August 1950, 5th AF established the Rescue Liaison Office within the Korean Joint Operations Center (JOC). Rescue Co-ordination Centers, operated by the JOC under the control of FEAF, were set up at Johnson, Itazuke and Misawa ABs. From these three centres, all rescue attempts were co-ordinated using resources from all available UN forces. Any land mission received fighter support and top cover from 5th AF F-51Ds and F-86s. If the mission was outside the range of the H-5 or H-19, rescue equipment was air-dropped to the downed flier, usually by SC-47, with instructions indicating how far he had to walk before he could be picked up. Such 'walks' were reasonably rare, as the helicopters would often stage through small, crude air bases that had been created well behind the MLR and stocked with fuel and supplies.

Air Rescue personnel made the first mass evacuation flights during the Korean War. The H-5, and later the H-19, could go where no other rescue aircraft could – right into the heart of a combat situation, no matter what the terrain. In the past, casualties first had to be transported by vehicle to a nearby Mobile Army Surgical Hospital (MASH), given emergency treatment, then transported again to the nearest true medical facility, either a hospital in Japan or a hospital ship. The process took more hours than many wounded soldiers had. The helicopter, though, could land near the combat zone in any clear area, pick up the wounded GIs, and transport them directly to the nearest hospital facility. And, of course, no conventional rescue aircraft could perform such a task if the mission took them deep inside North Korea, China or Manchuria.

In-country missions

The mission of the 3rd Rescue Squadron was to undertake these in-country medical transfers and rescues. Using the Sikorsky H-5 and H-19, plus the Stinson L-5 flying ambulances, the men of the 3rd RS performed some 618 medical transfers between the start of the war and 1 January 1951. The L-5 crews transferred 56 men to hospitals in the rear areas. This unit was composed of 11 officers and 56 enlisted men, initially designated Flight D Detachment, but changed to Detachment F on 30 August 1950, and finally to Detachment One on 22 June 1951. On 11 November 1952, the Air Force began a large reorganisation of its units. Within the Air Rescue Service, all squadrons became groups, and flights became squadrons. Thus the 2nd and 3rd RSs became the 2nd and 3rd ARGs. On 1 March 1953, Det One was redesignated the 2157th ARS.

Det One, 3rd RS was involved in several

An H-5 and an SB-17G are seen on the ramp at Kadena AB, Okinawa in the summer of 1950. Kadena was 'home plate' for the B-29s of the 19th Bomb Group. The H-5 was used for short-range rescue missions, out to 65 miles (105 km), while the SB-17Gs escorted the B-29 strike force to Korea and back (until replaced by SB-29s).

spectacular and ground-breaking missions in Korea. On 15 February 1951, the detachment's six H-5s took off for Chip-Yong Ni, some 20 miles (32 km) east of Seoul. An American unit was cut off and surrounded by the enemy, and had already suffered many casualties. The six H-5s flew badly-needed supplies to the beleaguered unit, then loaded a couple of

Above: An SC-47D from Flight 'C', 1st Rescue Squadron rests on the ramp of the rescue operation based at Chodo Island, about 50 miles (80 km) north of the Main Line of Resistance – well behind Communist lines. Chodo also had a major ground control intercept radar facility in addition to the rescue detachment.

An SA-16A takes off from Itazuke AB, Japan in May 1951. The 3rd Rescue Squadron had SA-16 detachments at coastal bases in Japan, and at Taegu and Seoul City in Korea.

No. 1 SNAFU

Major Flamm 'Dee' Harper sits in the cockpit of an F-86F in Korea during 1953. Major Harper was assigned to the 18th Fighter Bomber Group based at Osan AB (K-55), flying F-86F Sabre fighter-bombers, when he was shot down on 28 June 1953.

The primary aircraft team of the 3rd Rescue Squadron in 1951 was the Sikorsky H-5 Dragonfly and the Grumman SA-16 Albatross. Detachment One of the 3rd RS was located at Seoul City AB (K-16), just a few miles behind the MLR in the summer of 1951.

28 June 1953 started as did most other days in the closing months of the Korean War – busy. The mission that day was a strike against a rail bridge on the Haeju Peninsula, what was considered to be a relatively safe area. 'A 'milk run', but an interesting mission that I had planned and would help execute. Little did I know just how interesting it would be.

Arriving over the target, we made individual attacks which would allow the delayed fuses [on our bombs] to detonate. I was the last aircraft on the bomb run. The bombs all missed because they stuck in the soft silt of the river banks, instead of 'skipping' to the target. As I came off the target, I stayed low, then went into a shallow climb to the left at well over 400 kt. Passing over a small marshalling yard with a few boxcars on the rails, I noticed some tracers curling towards me. They were 23-mm, and the troops on that gun were very good. Every round that missed was out in front of my Sabre.

Then I heard two dull clunks in the front of the Sabre. At about the same time my flight leader called out the boxcars and decided to hit them before we left the area. I told him about the gun, and that I would take it out since I knew where it was. The rest of the flight hit the boxcars as I knocked out the gun position using my six '50s'. We then rejoined and climbed to cruise altitude for the flight home to K-55.

Around 16,000 ft, I noticed a vibration in the front of the aircraft. Reducing power, I levelled off while the rest of the flight closed in for a look-see. Just as they closed in, the engine exploded, ripping the throttle out of my hands, and going to 'IDLE' position. The flaps went full down, but retracted when I hit the lever. I shut the engine down, turned off the fuel system, and set up a glide to the west. I knew it would not make it home and was hoping to reach the coastline before leaving the aircraft.

It was about that time that Major Harry Evans slid in on my wing and calmly said, "'Dee', you've got about 200 ft of flame following you." The necessary Mayday calls were made, and an SA-16 was scrambled from Chodo to meet me at the coast. But about 10 miles short of the coast, Major Evans called again. "'Dee' you better get out. You look like a roman candle." But I saw no smoke or flames in the cockpit, nor any in my vision of the outside of the aircraft, so I decided to ride it out.

About 5 miles from the coast, a second explosion occurred. This one shook me, and I could now see flames and smoke in the cockpit. It was time to go! I'd have to walk the remaining miles to the coast. I tightened everything up, and pulled the levers. The bang from the canopy charge startled me so much that I froze. After a few seconds I realised what it was and pulled the second trigger. Bang – I was out!

I made a free fall from about 8,000 ft to avoid being spotted from the ground. I fell head first, but on my back! Every time I started to straighten out, I'd flip onto my back. Finally looking around, I could see the leaves of the trees. Holy cow, that's the ground! Frantically I pulled the rip cord. My 'chute blossomed, then collapsed as I smacked the side of a rocky cliff. I landed right on top of a large boulder, which caught me right in the middle of my back. All I could think about was – "What a hell of a way to die! Draped over a rock in a North Korean canyon!"

Only those airmen who have been downed in enemy territory truly understand the meaning of 'lonely'. The feeling is so intense that it often immobilises an individual. I had already been downed once, when I had to crash-land my P-38 in France after taking out a German ammo dump. I spent 22 days in France before getting back to friendly lines. During those 22 days, every bend in the road brought a whole German division looking for me. At least, that's what it felt like.

Back on the Haeju Peninsula, I rolled off the boulder in a lot of pain. At the very least, I had a couple of broken ribs. The adrenaline was starting to flow and I knew I had to start doing something if I was to make it out. Apparently no one had seen me come down. The North Koreans were busy heading to where my Sabre had impacted the earth. I hid my parachute and started the long walk to the coast. I planned to be in my dinghy, paddling out to sea before the sun came up again.

After travelling about a half mile, a flight of F-84s came over. They were making passes over the crash site trying to locate me. Each pass took them right over my position. I grabbed my emergency radio and tried to make contact with them. Nothing! I'd survived the hard landing against the rock, but the radio had not. My only signalling device left was my 'chute – and it was back with the North Korean soldiers.

I started back up the hill to get the 'chute, but was stopped by Oriental voices. Two North Korean soldiers had found the 'chute. I knew the ResCAP was in place, and that a helicopter was probably close by – if I could signal them! I decided to go for broke, pulled my .45 pistol and started to move in. I knew I had to get in close, as I was never very good with the .45. And the odds were 2-1, no time for me to miss. I did not!

I immediately grabbed the 'chute, spread it on the ground and sat right down in the middle of it. The very first F-84 to pass over me spotted me, reversed his turn, came back and wagged his wings. But I could hear lots of enemy voices all around me. Then I heard another noise. Shortly thereafter, the most beautiful bird I ever saw popped over the crest of the hill. It was an H-19 scrambled from Chodo.

As the F-84s pinned down the North Korean troops, the helicopter moved in and lowered its sling. As soon as I was secure in the sling, the helicopter pilot suddenly pulled up to about 3,000 ft. There was not time to reel me in, as the ground fire was pretty intense. Then I felt the winch start to reel me in. As I was slowly being reeled in, I noticed that there was a movie camera attached to the hoist boom, which was taking pictures of my rescue. The corpsman was not even in position to help me aboard as I was pulled alongside the open door of the helicopter. He was the one running the camera!

Hanging there in mid-air, I decided I'd had enough of this. My fingertips could barely touch the edge of the door opening, but it was just enough and I yanked myself into the cabin and onto my feet. Boy, adrenaline can work wonders! The pilot asked if I was OK, and I told him about my broken ribs. He asked if I was well enough to return with the helicopter to Chodo to refuel and go back 'on station'. There were still missions north of the bomb line and he was the only helicopter in position for any other rescues. He'd take me back to K-16 the next morning.

I was agreeable to anything at that point, and stood in the door watching Korea slide away underneath us. Pretty soon, the adrenaline started wearing off and I began feeling a little rocky. There was a stretcher on the floor and I decided to lay down on it. It took four guys at Chodo to get that stretcher out of the cabin, as I could not move. It took two men to change me from laying down to a standing position.

My ordeal still was not over. Twice during the night, the helicopter pad and radar site at Chodo was subjected to bombing attacks by the North Koreans. The bombing was erratic, but it did force us out of our bunks into tunnels that had been dug in the nearby hillside. Everyone selected his own tunnel and crawled in. The holes were plenty big, but in my condition, it was like trying to crawl into a gopher hole.

Next morning, true to his word, the H-19 pilot delivered me to the 121st Air Evacuation Hospital at Seoul City (K-16). I knew that if I stayed there, I would be evacuated back to the US – which I did not want to be, just yet. When my CO came to visit, I asked him to have me transferred to the hospital at my home base of K-55. I still had a war to fight! But fate entered the picture again. The Korean War ended on 27 July 1953, and I was not back on flying status until 28 August.

Oh yes, the film that corpsman shot of my rescue was broadcast on national TV four days later. Not the best way for your family to be notified of your latest escapade. According to Air Force records, I am probably the only airman to successfully crash and evade the enemy in two different wars. It's not a record that one strives to achieve.

Major 'Dee' Harper, 18th Fighter Bomber Wing

***H-19s were often equipped with large pontoons, known as 'hot dogs', for sea operations. This Detachment One H-19A shares a field 'ramp' near a Mobile Army Surgical Hospital with a Navy HO3S-1 from the USS* Princeton.**

Right: 3rd Rescue Squadron mechanics install the framework on which will be mounted the covered litters on this H-5G at Taegu, while the aircraft's rotor head receives attention.

Another 3rd RS Dragonfly, with external covered litter carriers fitted, undergoes minor repairs on the ramp at Suwon AB in 1952.

wounded GIs aboard for the return flight. Each crew made three flights in and out of the hostile area that first day.

On the second day, only four flyable H-5s were available. Again, the helicopters made their way in and out of the besieged area, complicated by a blizzard and 40-mph (65-km/h) winds. The H-5s flew all day, evacuating a total of 52 men. The ground unit finally fought out of the trap after C-119s air-dropped ammunition and heavy weapons, while F-51Ds bombed and strafed a path through the Chinese.

Det One's H-5s flew 75 sorties to Munsan-Ni, following the successful paratrooper operation on 23 March 1951. FEAF C-119s dropped the 187th Regimental Combat Team some 10 miles (16 km) behind the Chinese lines at Munsan-Ni. Between 23 and 29 March, Det One's H-5s evacuated over 300 paratroops, all under very heavy mortar and machine-gun fire. In July 1952, 3rd ARG helicopters saved some 710 UN troops that had been trapped by flooding along the MLR.

In the summer of 1952, 5th AF F-86s shot down a MiG-15, which crashed but did not explode, in the mouth of the Yalu River. The MiG was virtually intact and the Air Force wanted to study it – if they could get it out of the area. With swarms of F-86s overhead, Captain Joseph Cooper flew a 581st ARCS H-19 to the location and landed on a nearby island. The MiG was dismantled through the ingenious use of precisely placed hand grenades, and then loaded aboard the H-19, which made for a 1,000-lb (454-kg) overload, for the flight back to Chodo.

Rescuing UN airmen

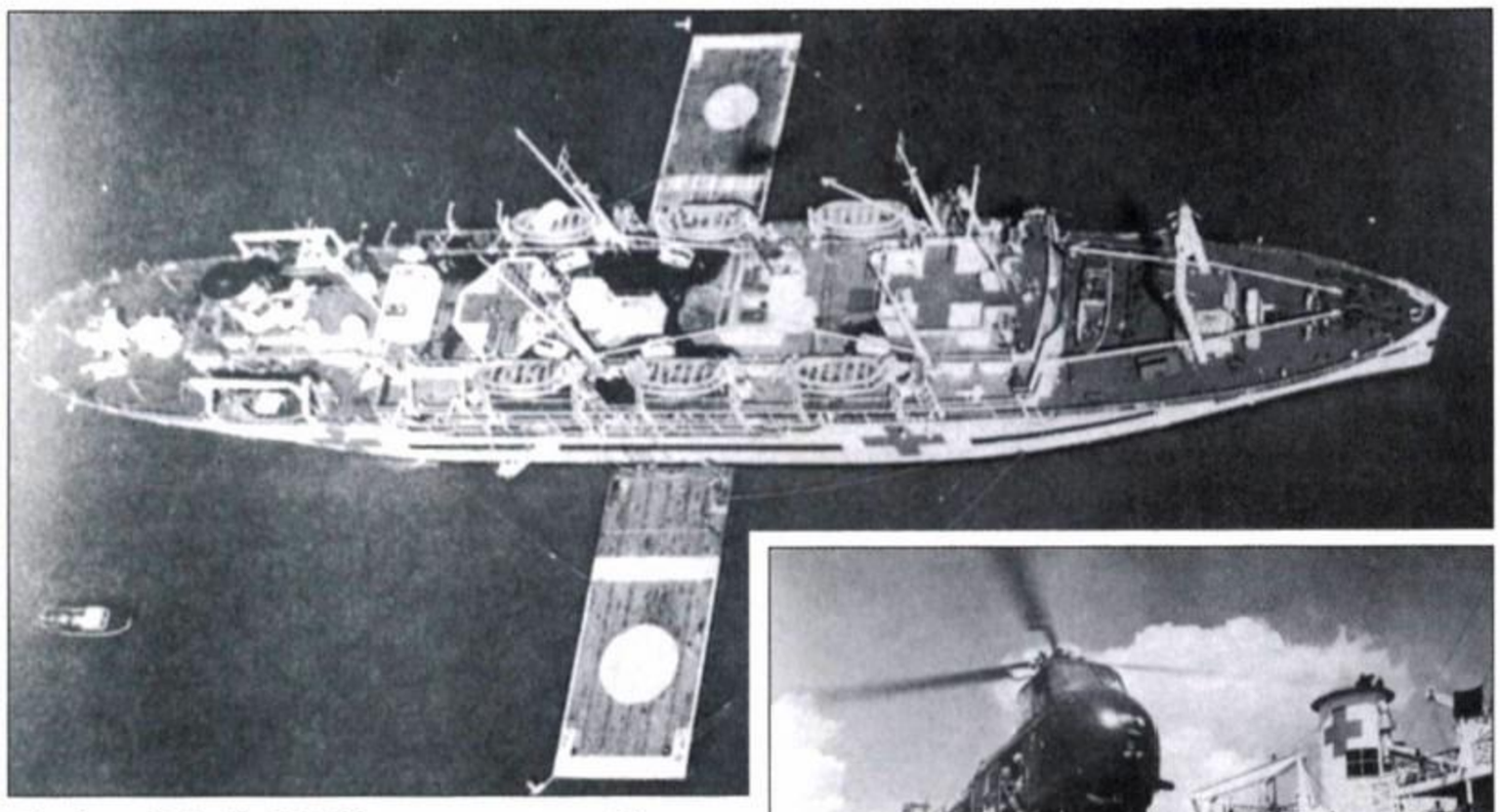
Rescue of downed UN airmen was the primary mission of the air rescue forces. The first recorded rescue of a downed pilot in Korea occurred on 4 September 1950. A Det F H-5 piloted by Lieutenant Paul Van Boven rescued Captain Robert Wayne after his F-51D was shot down near Hanggan-Dong. It was just the first of many such rescues. On 12 October 1950, Lieutenant David McDaniels took his H-5 65 miles into North Korea to recover Lieutenant Stan Leonar, a downed Royal Navy Sea Fury pilot, serving with No. 807 Squadron aboard HMS *Theseus*. With Lieutenant McDaniels was Captain John Shumate, one of Det One's paradoctors. Lieutenant McDaniels put the H-5 down in a clearing about 200 yd (183 m) from the surrounded RN pilot. Shumate ran to the wounded British pilot, scooped him up and threw him over his shoulder, and sprinted back to the helicopter, all under withering small arms fire. As soon as McDaniels had lifted off, Shumate began an emergency transfusion that saved the life of the British pilot, the first transfusion ever performed aboard a helicopter in combat. Both McDaniels and Shumate received the Silver Star.

Air Force aircraft and helicopters rescued many Navy/Marine flyers downed in and around Korea. In June 1951, a Marine F4U Corsair was hit by Communist anti-aircraft fire, forcing the pilot to bail out. Surrounded by the enemy, the Marine pilot was finally captured and was about to be taken to a North Korean POW camp. Just before he left the aircraft, the pilot had notified the Rescue Control Center of his position and predicament. Immediately, a flight of four 18th FBG F-51D Mustangs was scrambled out of Chinhae. Their job would be to pin down the enemy troops so that an H-5 from Seoul City could recover the pilot; the troops were forced into a nearby ditch, taking the captive Marine pilot with them. The Mustangs could do little more than orbit nearby, as the enemy were using the Marine as a shield. About this time, the H-5 from Det One arrived. The helicopter crew saw the situation and immediately swung into action.

As the pilot rotated directly over the ditch and the enemy troops, the paramedic used his M1 carbine to fire down – with devastating accuracy. The Chinese scrambled out of the ditch and away from the American helicopter gunner, leaving the Marine pilot behind. As the H-5 swooped in to pick him up, the F-51s made quick work of the remaining Chinese. The H-5 hovered over the ditch, lowered the pick-up, pulled the Marine aboard, and scrambled for home. The H-5 was full of holes

Captain Walter Hodgson, an H-5 pilot assigned to the 3rd Rescue Squadron, receives last minute instructions from the commander of a radar site just across the MLR in Korea. Hodgson had just loaded up an injured Ethiopian UN soldier after battling vicious winds at the mountain top site.

Medics and 3rd Rescue Squadron personnel carry an injured GI to the waiting ambulance at Itazuke AB, Japan in 1951. Two early production SA-16A amphibians share the ramp.



*The hospital ship **USS** Haven was moored in Inchon harbour, with two helicopter landing pads attached to the middle of the ship. All the service helicopters could bring badly wounded personnel directly to the **Haven** from either the front lines or from a **MASH** unit; the latter would stabilise the wounded **GI** to withstand the flight to the **Haven**.*

*Above: A Marine **HO4S-1** comes in to land on one of the helicopter pads alongside the hospital ship **USS** Haven. The **HO4S-1** (**H-19A**) could hold up to eight litters internally, which was a vast improvement over the external carriage of just two litters on the Sikorsky **H-5** types.*

*Below: An **H-19C** from the 13th Helicopter Transportation Company unloads a patient at Kimpo AB in 1953. The wounded **GI** was first stabilised at a nearby Mobile Army Surgical Hospital, flown to Kimpo by **H-19**, then put aboard a **C-54** ambulance aircraft and transported to a hospital in Japan.*

and leaking fuel, but no one was wounded and the pilot brought everyone home.

Many times, Navy HO3S-1s (H-5s) would pick up a wounded Navy pilot and fly him to Chodo, where he would be loaded aboard an Air Force SA-16 for the flight directly to the nearest military hospital in Japan. In September 1952, a 3rd ARG H-19 came to the aid of its Navy comrades. A Navy HOS-3 had attempted to recover a downed Navy pilot from the Yellow Sea, but crashed during the attempt. The Air Force H-19 was scrambled from Chodo, and pulled both the Navy pilot and his rescuers from the ocean.

Several of the top-scoring aces in the Korean War were themselves downed and almost captured or killed. Captain Joseph McConnell was shot down on 12 April 1953. 'Mac' had just shot down his eighth MiG when his Sabre was hit by gunfire from other MiGs, and he was forced to eject into the Yellow Sea. A Det One H-19 deftly plucked him from the ocean, and he went on to shoot down another eight MiGs, becoming the top-scoring ace in the Korean War. Captain Lonnie Moore suffered an engine failure in one of the experimental Gunval F-86s with 20-mm cannon on 30 April 1953; he, too, ejected into the Yellow Sea and was picked up by an H-19 from Chodo.

The SA-16s from the 3rd RS were involved in some of the longer-ranged rescue missions. Often, they worked as a team with H-5 and H-19 helicopters. The H-5 would make the pick-up in hostile territory where the SA-16 could not land, then transfer the downed aviator to a nearby island where the Albatross was waiting. The SA-16s were based at Seoul City AB (K-16). Any mission that went to 'MiG Alley' in northwest Korea had SA-16 support. The big Albatross would orbit just north of Chodo and await any Mayday calls.

Night SA-16 rescue

There were exceptions to that plan, of course. On the night of 11 June 1951, Lieutenant John Najarian performed an incredible rescue that defied all the odds, and went against all flying rules. Captain Ken Stewart, flying an F-51D Mustang with the 18th FBG, was hit by flak north of the Taedong River. Forced to bail out of his burning Mustang, Captain Stewart landed in the river, inflated his raft and made for shore until darkness could cover his movements. Overhead, the rest of his flight orbited nearby, pinning down any enemy troops that started in his direction. At the same time, they radioed the Rescue Co-ordination Center requesting a pick-up. Since the location was beyond the range of the H-5s in the 3rd ARS, an SA-16 Albatross was directed to the scene. A river landing would be risky, but it was a water rescue situation.

Lieutenant Najarian and his crew were the alert aircraft. They scrambled out of K-16, Seoul City AB, and headed north. Crossing over the MLR, Lieutenant Najarian's SA-16 was joined by an element of F-51s, which would provide support. By the time Najarian reached the downed flyer, darkness had settled over the area. It was almost completely black, as clouds hid the moon. The only light was provided by the North Korean flak trying to find the rescue team.

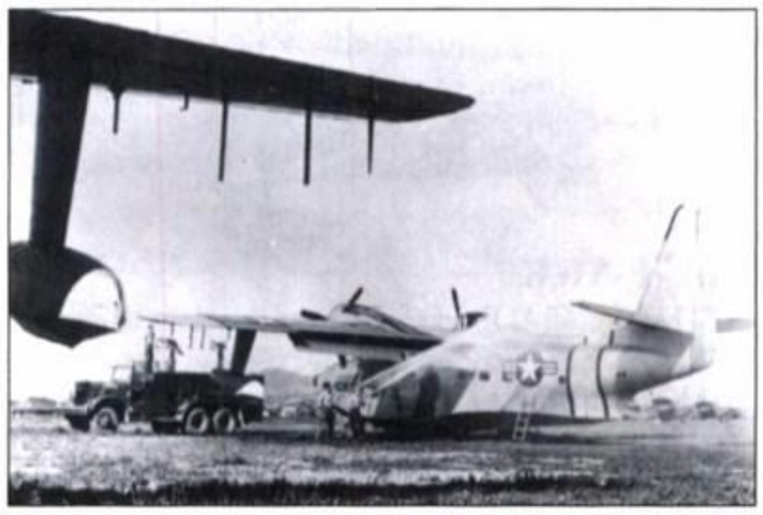
Najarian faced a dilemma. He did not want to leave the pilot within the grasp of the enemy, but no one had ever attempted a night water landing in an SA-16 before. Worse, this particular river had obstacles to make the landing even more hazardous – debris clogged it, and high tension wires were strung at various points on both banks. No one in either the SA-16 or the Mustangs knew anything about the river – its depth, location of sand bars and outcroppings, bends in the river. Even the altitude of the river was unknown.

The SA-16 pilot made a decision. He was unable to use his own landing lights, as the anti-aircraft guns would cut him to pieces, but he could have one of the Mustangs use theirs to

A 581st Air Resupply & Communications Squadron YH-19A, actually a CIA aircraft, was used to transport the United Nations negotiating team to the Korean peace talks held at Kaesong.

Ashiya AB, on the northern shore of Kyushu, is filled with C-119 Flying Boxcars and C-54s from FEAF Combat Cargo Command. In the foreground are an armed SB-17G and an SA-16A of the 3rd Rescue Squadron, which would escort the cargo aircraft over the Korean Straits.

Below: Members of the 18th Fighter Bomber Group use high-pressure fire hoses to wash mud and salt water off a 3rd Rescue Squadron SA-16A at Chinhae AB in July 1951. The 3rd RS had two-aircraft SA-16A detachments at bases as close behind the Main Line of Resistance as possible.



guide him down to the river. As Najarian began his approach, one of the F-51Ds slid in front, lowered its landing gear and turned on its landing lights. Najarian slowly followed the lead of the Mustang, and settled the big flying-boat onto the river. The problem now was how to locate the downed pilot in the dark. He was reasonably sure that Captain Stewart was in his immediate area, but did not know exactly where. He started to idle up and down the river. Suddenly, he saw a blinking light on the east bank. A flashlight – was it Stewart or a Chinese soldier baiting a trap? The light blinked out several Morse code words, one being the code for the day. Najarian idled to the shore and waited while the pilot swam to the aircraft.

Once Captain Stewart was aboard, Lieutenant Najarian faced the task of a night water take-off from a river, under hostile fire and with no landmarks. As the F-51Ds pinned down the troops firing in the direction of the Albatross's engine noise, Najarian turned up-river and started his take-off run. In the far distance, he could faintly make out the outline of some type of peninsula jutting into the river. This was his 'horizon'.

The SA-16's speed picked up – luck held and no sand bars were encountered – and the big amphibian lifted smoothly off the water. Now all they had to face was the increasing amount of North Korean flak just ahead. Najarian bent the big aircraft over into a tight climbing turn to the south, went 'balls to the wall' with the throttles, and headed for home. The Mustangs flew escort all the way back to Seoul. Lieutenant John Najarian was awarded the Distinguished Flying Cross for his actions by the Air Force – and was never able to pay for a beer at any air base in South Korea for the remainder of his tour.

Ten per cent recovery

During the Korean War, 1,690 US airmen went down in enemy territory. Although a great many were captured, and many lost their lives either as a result of the crash or in captivity, some 10 per cent were rescued. Air Rescue Service crews pulled 170 Air Force personnel out of North Korean territory, and picked up an additional 84 flying for UN forces. Air rescue crews saved a total of 9,680 US personnel during the three years of war on the ground, in addition to evacuating 8,598 medical casualties. Of that total, 9,210 were lifted out by helicopters. Plus, 996 UN personnel were rescued from behind enemy lines, 846 by helicopter.

The Korean War, of course, was not the only thing going on in the world during the early 1950s. Air Rescue Service crews performed a large number of rescues and mercy missions elsewhere. On 25 September 1950, an ARS H-5 located and recovered the 16-member crew of a SAC B-50 bomber that had crashed some 95 miles (155 km) southeast of Goose Bay, Labrador. During the July 1951 Kansas-Missouri floods, SA-16s and SB-29s from the 4th and 5th ARSs dropped over 200 tons of food and supplies to flood victims. One of the SB-29s dropped an A-3 lifeboat to a group of trapped civilians, resulting in the rescue of 439 people in one day.

On 12 February 1952, a 54th ARS SC-47 located the crash of a SAC B-36 near Goose Bay, and two pararescuemen were air-dropped into the region. Landing in 8 ft (2.4 m) of snow, and with the temperature at -20°F (-28°C), the pararescuemen soon found the B-36 crew, tended to their medical needs and helped set up a shelter. The next morning an H-19 flew out the survivors. On the night of 11/12 April 1952, an SA-16 from Flight C of the 1st ARS pulled six survivors of a Pan American DC-4 (N88899) from the Caribbean Sea near Puerto Rico.

Air Rescue Service demonstrated its ability to react quickly by setting a long-distance flight record for helicopters under Project Hop-A-Long. Taking off on 15 July 1952 from Westover AFB in New York, Captain Vincent McGovern and Lieutenant Harold Moore flew a pair of H-19s across the Atlantic Ocean, hopping from Westover to Presque Isle, Maine to Goose Bay to Narsarssuak to Keflavik to Prestwick to Schiphol, landing at Wiesbaden on 31 July. Two days after the record flight, the two H-19s were involved in a rescue.

One of the strangest rescues took place in the Mediterranean Sea that same month. On 27 July, a DC-3 crashed near Malta. A 58th ARS

Right: An H-19A from Detachment One, 3rd Rescue Squadron pulls a USAF F-86 pilot from the Yellow Sea in 1952. The 2nd and 3rd RSs were elevated to Group status in 1952. Captain Joseph McConnell, the top-scoring ace in Korea, was rescued from the Yellow Sea by 3rd RG H-19s the following May, having been shot down by MiGs.

An Air Force rescue boat pulls in to the dock at Miho AB in 1952; they patrolled the Korean Straits whenever any aircraft were over the water. The flying bridge bears the insignia of F-51-operating No. 2 Squadron, SAAF.

Convair converted 38 C-54Ds to SC-54D (HC-54D after 1962) Rescuemaster standard with extra fuel tankage and search radar installed.

Below: Survivors of the ocean racer* Elda *huddle together in one of the Air Rescue Kit, or 'ARK' rafts dropped by a 29th ARS SC-54D.

Above: Captain Jack Woodward's SA-16 taxis to a raft filled with survivors from the Cathay Pacific DC-4 that was shot down by Chinese MiG jet fighters on 23 July 1954. Woodward rescued nine survivors from the DC-4, and was awarded the Distinguished Flying Cross.

SA-16 was scrambled and rushed to the area, where the crew located a large group of survivors and put the Albatross down nearby. There were 32 survivors in the group and all were pulled aboard the big flying-boat – rendering the SA-16 overloaded, and unable to take off. Captain Kendrick Reeves had to make a decision – put half of the survivors back in the water with the promise to return later, or keep everyone aboard and wait for another rescue craft to come. He chose to remain with all the survivors aboard. His problem was solved by a nearby Royal Navy destroyer that sped to the scene. As the destroyer pulled up near the flying-boat to recover all the survivors, a swell caused the destroyer to hit the SA-16, rendering it unflyable. The destroyer crew threw a tow line to the flying-boat, and towed the Albatross, its crew, and the DC-3 survivors back to port. Captain Reeves received the Cheny Award for his actions.

Post-war changes

Following the end of the war in Korea, the Air Force Air Rescue Service underwent many changes. The ARS was now twice as large as it had been at the beginning of the war, jumping from 3,000 to over 6,500 members. In January 1954, the entire Air Rescue Service was reorganised. Groups and squadrons were added in some places, deleted in others. In the area of Korean War operations, three groups were operational – the 2nd, 3rd, and 11th. The 11th ARG was inactivated totally. One of its squadrons, the 76th ARS, remained at Kwajalein under the control of ARS Headquarters. The 78th ARS was inactivated, and the 79th ARS was transferred to the 2nd ARG. Both the 2nd and 3rd Groups were reduced in strength. The 2nd ARG lost the 32nd and 34th ARS, and the 3rd lost the 37th and 2157th ARS – the veteran combat unit known as Det One during the Korean War.

While the ARS itself was being reorganised, the Air Force was making a decision regarding new aircraft for the mission. The SB-17s and SB-29s were both approaching the end of their airframe lives. In 1953, the USAF decided to use modified C-54s to replace the SB-17G, SB-29 and SC-47. Using modified Douglas C-54D aircraft as the basis for the new rescue aircraft, the SC-54D Rescuemaster was a vast improvement over the converted bomber types. With additional fuel tanks installed in the cargo area, it could stay aloft for over 18 hours. The cargo door was modified so that it could be opened in flight to drop equipment, supplies and pararescuemen. Large B-36 scanner blister windows were installed on both sides of the rear fuselage.

MA-1 ARK

The SC-54D was equipped with the new MA-1 Air Rescue Kit, or 'ARK'. The MA-1 ARK consisted of a pair of 20-person life rafts and three survival kits. The two rafts were connected with 840 ft (255 m) of buoyant life-line to which survivors could cling, with the three survival kits attached. Each SC-54D carried four MA-1 Kits, making a single aircraft capable of rescuing some 160 people. The boat-carrying SB-17 and SB-29 had a maximum rescue capability of 14 persons. The first SC-54D Rescuemaster began entering the inventory in October 1955, and Convair Aircraft Co. modified a total of 38 C-54Ds to Rescuemaster specifications.

The venerable Grumman SA-16A was also improved. The new Albatross had a wing span extended from 80 ft (24.4 m) to 96 ft 8 in (29.5 m), and horizontal tail surfaces extended 12 in (30.5 cm). The vertical tail assembly was enlarged slightly, and then moved aft some 8 in (20 cm). Improved engine performance resulted in the range increasing to over 3,000 miles (4825 km). The modified aircraft were designated SA-16B, and the first one flew on 25 January 1957. The Air Force eventually modified a total of 241 SA-16As to SA-16Bs.

The assets of the helicopter arm of the ARS was also greatly improved. In 1954, the USAF

Above: This winterised Vertol SH-21B was assigned to the 55th Air Rescue Squadron at Thule AB, Greenland in 1958. The twin-rotor SH-21B was powered by a single 1,425-hp (1063-kW) R-1820 piston engine. The SH-21B configured for the air rescue mission had a pair of 400-US gal (1514-litre) external fuel tanks, which extended the range to over 650 miles (1046 km).

This Vertol YH-21 was tested by the Air Force's Air Research & Development Command at Wright-Patterson AFB in September 1954. The H-21 could transport up to 20 passengers or 12 litters, and had a range of 650 miles when external fuel tanks were installed.

With its reinforced keel, the SA-16 could have a large ski attached to the fuselage bottom and a pair of small outrigger skis attached to the floats, making it a true triphibian. This SA-16 rests on Mud Lake, near Goose Bay, Labrador.

began replacing both the H-5 and the H-19 with the Vertol H-21. The twin-rotor H-21 was modified for the rescue mission by addition of an electric hoist capable of lifting a 400-lb (180-kg) load. A radio compass was installed, the aircraft was winterised, and had attachments to the underside of the fuselage for external fuel tanks. Designated SH-21B, the new helicopter could hold either 20 passengers or up to 12 litter cases. Powered by a 1,425-hp (1063-kW) R-1820 Wright Cyclone engine, the SH-21B had a top speed in excess of 120 mph (193 km/h) and, with external tanks fitted, a radius of action exceeding 325 miles (523 km). The first SH-21Bs were delivered to the 6th and 10th ARGs in 1956.

By the end of the 1950s, the Air Rescue Service was composed of 12 groups and 38 squadrons. Within the United States were the 4th, 5th and 8th Groups. The 1st ARG covered the Caribbean from bases in the Panama Canal Zone, Puerto Rico and Bermuda. The 6th and 9th Groups covered the North Atlantic from Newfoundland to England. The 7th ARG had its four squadrons stationed at Lajes, Sidi Slimane, Tripoli and Dhahran, and covered the entire Mediterranean Sea area. The 12th ARG was assigned to USAFE control. The Pacific area was covered by the combat veteran squadrons within the 2nd and 3rd Groups based in the Far East. The 10th Group covered the Alaskan area. The 76th Squadron was based in Hawaii.

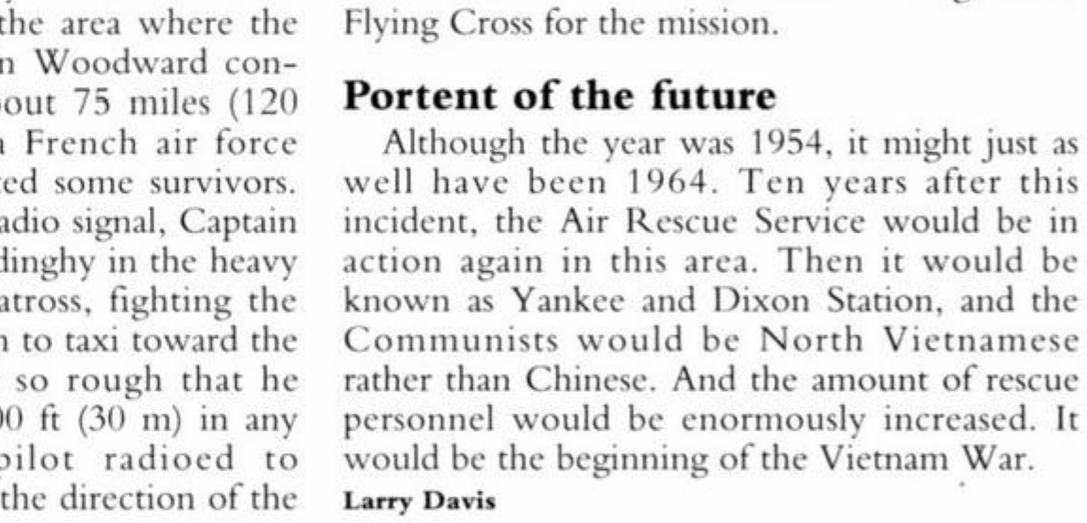
Cathay Pacific crash

It was in the Far East that the 'peacetime' rescue service was introduced to the horrors of war. On 23 July 1954, a Cathay Pacific DC-4 airliner was shot down by Chinese MiG fighters off the island of Hainan in the South China Sea.

A trio of SB-29s is seen on the transient ramp at Maxwell AFB, Alabama in 1957. The SB-29A was a standard B-29 modified to carry the type A-3 air-droppable lifeboat.

Left: H-19A* Hop-A-Long *participated in a record flight from Westover AFB, NY to Wiesbaden AB, Germany from 15 July 1952. The flight took 16 days to complete, after which the H-19s entered active service, flying a rescue mission the following day.

Right: A 6th RG SA-16A is seen at a base in southern Greenland, with its crew ready for inspection during spring 1955. The MATS badge indicates the 55th ARS came under its command.



The airliner had 18 passengers and crew aboard. Thirty minutes after the attack, Captain Jack Woodward, an SA-16 pilot with the 31st Air Rescue Squadron, lifted off from Clark AB in the Philippines and headed toward the downed airliner. Although warned by the Chinese Communists that any military aircraft would be shot down if they entered the area where the airliner went down, Captain Woodward continued his flight north. About 75 miles (120 km) from the crash site, a French air force PB4Y-2 Privateer had spotted some survivors. Homing on the Privateer's radio signal, Captain Woodward spotted a single dinghy in the heavy seas. He set down the Albatross, fighting the 10-ft (3-m) swells, and began to taxi toward the dinghy, but the seas were so rough that he could not see more than 100 ft (30 m) in any direction. The PB4Y pilot radioed to Woodward, steering him in the direction of the dinghy. When Captain Woodward pulled alongside the raft, the tarpaulin was pulled back to reveal nine survivors, including Captain Blown, the pilot of the DC-4. Woodward made the difficult take-off look normal, and flew back to Clark without incident. Captain Woodward was awarded the Distinguished Flying Cross for the mission.

Portent of the future

Although the year was 1954, it might just as well have been 1964. Ten years after this incident, the Air Rescue Service would be in action again in this area. Then it would be known as Yankee and Dixon Station, and the Communists would be North Vietnamese rather than Chinese. And the amount of rescue personnel would be enormously increased. It would be the beginning of the Vietnam War.

Larry Davis

Right: At the request of the Air Rescue Service, which was keen to improve the range, speed and single-engine performance of the SA-16, Grumman developed the SA-16B, with longer-span wings and greater internal fuel capacity. This aircraft, 51-7150, carries standard Air Rescue Service markings and twin 295-US gal (1117-litre) drop tanks. In all, 87 SA-16As were modified to B standard, the first flying in 1956.

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